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How Psychosis Can
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then Crush It

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Memory Upgrade

**Erasing bad memories
could ease anxieties**

Keys to Emotion Control

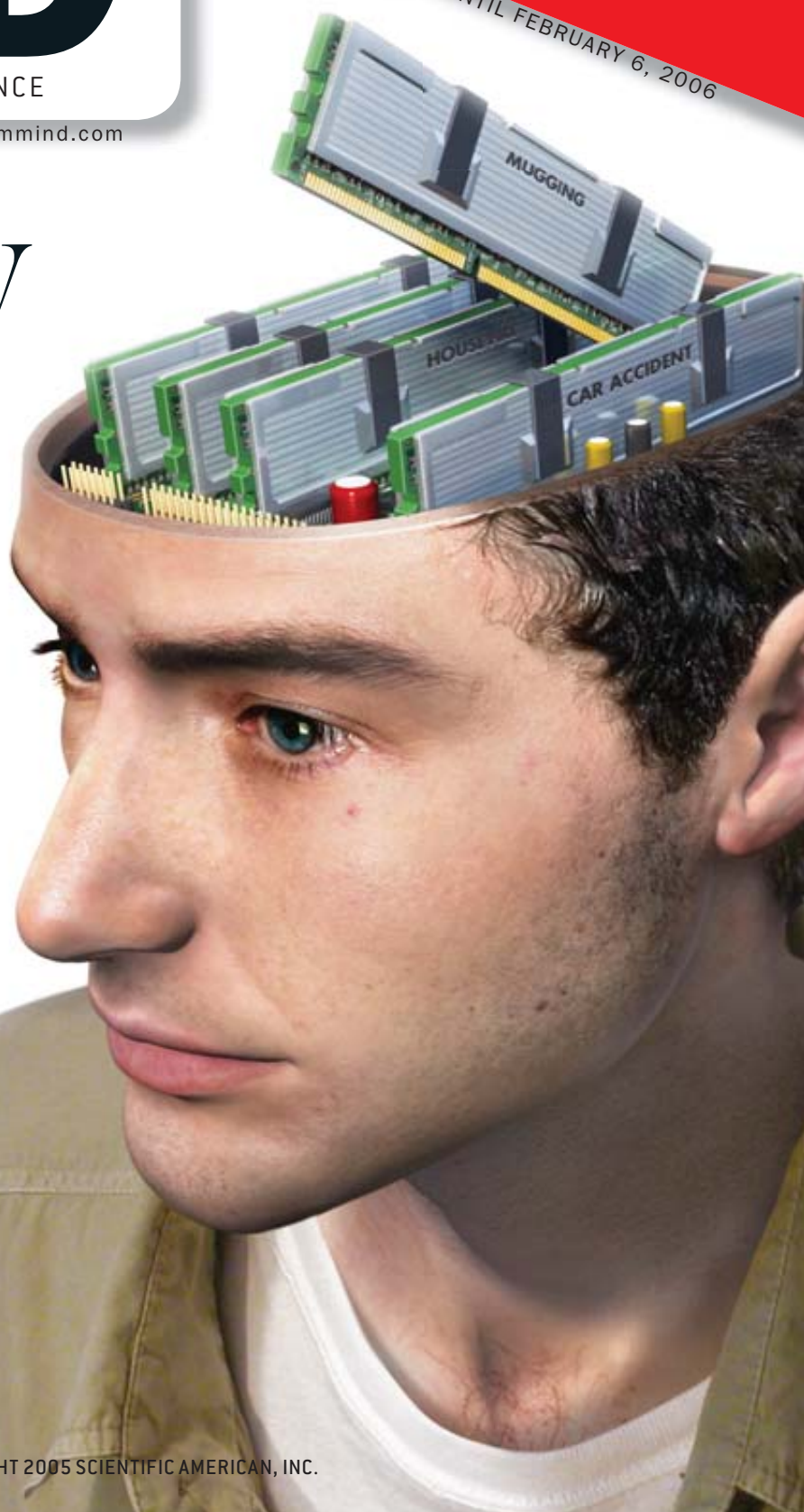
The Promise of E-Therapy

Why Left-handedness?

Self-Esteem Illusions

Myths Explained

Cures for Fear



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SCIENTIFIC AMERICAN MIND

THOUGHT • IDEAS • BRAIN SCIENCE

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Get the Picture

You and I haven't met, but I feel as if I already know you. You're pretty smart. Above average, in fact. And when you have a goal in front of you—whether it's completing a work project by the deadline, writing that term paper or getting all the dinner-party details just right—you're sure you'll rise to the occasion.

Me, too. Trouble is, we're often so very wrong about our overconfident self-assessments—and we are blind to that ignorance because we can't get a complete view of ourselves, as psychologists David Dunning, Chip Heath and Jerry M. Suls explain in their article "Picture Imperfect." Our muddled thinking impairs thousands of our everyday decisions, affecting our health, education and interactions in the workplace. hilariously (at least in hindsight), I became the embodiment of that principle when I promised to shape the authors' original 35,000-word paper into a 3,500-word story for this issue in "just a few days." A few weeks later an unsurprised but nonetheless amiable Dunning and company finally saw that edit. Turn to page 20 for the results.

Memories of such embarrassing failures are easy to laugh off. But what about harrowing, even traumatic, events that have been seared into our brains? They can haunt our waking hours and nightmares for years, if we ever make peace with them at all. What if we could simply delete these mental blemishes? In our cover story on "Erasing Memories," beginning on page 28, neuroscientist R. Douglas Fields reports how research could create the "spotless mind." Could the work be a balm for an anxiety-ridden culture—or put us on the numbing path of reflexively pill-popping our problems away, *Brave New World*-style?

By the way, I wasn't completely teasing about getting to know you. In the past, we have invited readers to sign up as advisers (www.sciam.com/feedback/). Now, in response to feedback, we have added two new features: a Calendar of worthwhile events, on page 19, and Ask the Brains, in which experts answer your questions about psychology and neuroscience, on page 94. We have also expanded the popular Illusions column, by neuroscientists Vilayanur S. Ramachandran and Diane Rogers-Ramachandran, starting on page 16. Of course, we think you'll like them—but we will try to understand it if you tell us we are being overconfident in that self-assessment.

Mariette DiChristina
 Executive Editor
editors@sciammind.com

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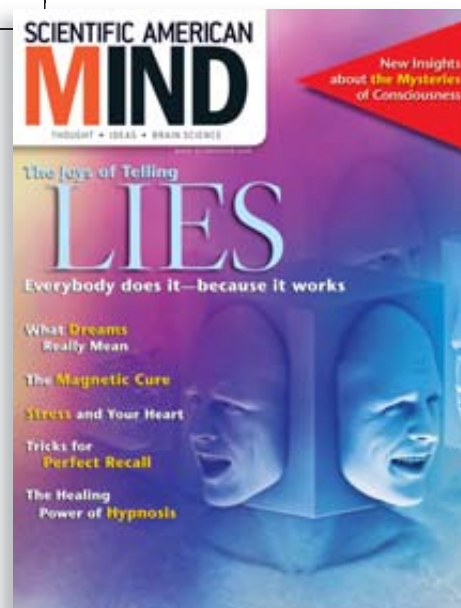
The collision damaged his forebrain. Surgeons saved it. But they never checked his pituitary, and he is no longer the man he was.

BY FELICITAS WITTE

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AH, THE VIRTUES OF LYING. The second issue of *Scientific American Mind* for 2005 explored the evolutionary benefits of fibbing—a kind of social glue that helps us get along with our fellow members of the human race—as explained by David Livingstone Smith in “Natural-Born Liars.” Naturally, the editors were all very interested to receive reader feedback on Smith’s article and the others in the issue. Yeah, that’s right. We got bags of beautifully handwritten notes, many of them rose-scented, congratulating us on the finest issue ever produced. In fact, the whole edition will soon be used as the basis for a major motion picture, starring our dear friend *Morgan Fairchild*. Yeah, that’s the ticket.



DECEPTION PERCEPTION

David Livingstone Smith's article, “Natural-Born Liars,” states that “perhaps mental health rests on self-deception, and becoming depressed is based on an impairment of the ability to deceive oneself.” He’s right on the money.

Smith gives many examples of self-deception, but I am a bit surprised he didn’t talk about the idea of “God” as

fer an eternity of nothingness to the fires of hell!

John Fitzpatrick
Calgary, Canada

I found Smith's piece more than a little depressing. It infers that the only successful people are those who deceive themselves and others. I’m not too surprised that political leaders are successful at deception or that this

to think these are characteristics humans admire as well. I have no doubt Smith is correct regarding the evolutionary heritage of our innate capacity for deception and self-deception. But let’s hope that even with that hardwiring people can encourage in themselves and others traits even a hen recognizes as important.

Paul Mealing
Victoria, Australia

MISUNDERSTOOD THERAPY?

If I wasn't already familiar with neurolinguistic programming (NLP), after reading “Psychotherapy Lite,” by Susanne Kemmer, I’d be likely to write NLP off as just another crackpot therapy. The story had many inaccuracies and tended to mislead as to the benefits of NLP. That is a distinct disservice to readers who will form an opinion solely based on the article. To refer to NLP as pop psychology describes the techniques incorrectly and fails to convey its legitimacy.

For those who want more information about NLP, a 1,600-page *Encyclopedia of Systemic NLP and NLP New Coding* is available on the Web site <http://nlpuniversitypress.com>

Tim Hallbom
Carmel, Ind.

Whereas it is true that “little scientific proof” of NLP’s effectiveness ex-

“Your article infers that the only successful people are those who deceive themselves and others. Are we meant to be pathological?”

one of the most significant and pervasive illustrations. It seems to me the people who stood around throwing flowers on a grave thousands of years ago realized that was where they were all headed, then manufactured a god to help them out. That was a pretty important act of self-deception.

It would not surprise me if a test of atheists and believers showed them both to be equally self-deceptive. The atheists, who probably include a lot of people who in childhood believed in a wrathful God, may now be practicing the self-deception that they would pre-

trait may be considered to have an evolutionary advantage. But I do question its virtue in the long term. Are we meant to be pathological? Consider some of our most successful world leaders of the past century: Hitler, Stalin and Mao.

About three years ago an Australian television science program called *Catalyst* ran a short feature on what made a successful rooster, with success being how well he was received by hens. The three attributes hens preferred were courage, honesty and being a good communicator. I would like

ists, Kemmer fails to note that fact is equally true of many psychotherapies that have been more thoroughly researched and are now broadly accepted by psychology professionals. Cognitive behavioral therapy has the best research validation, although its methods are crude, primitive and slow compared with NLP.

In contrast to most mainstream psychotherapies, NLP has clearly defined how to use the therapy and how to test the outcomes to assess a patient's improvement, making the process eminently suitable for definitive research. Many of us in the field would be happy to participate in such clinical research, under the most stringent and controlled conditions.

Steve Andreas
via e-mail

MIND AND BODY

Regarding "Head Attack," by Michael Feld and Johann Caspar Rüegg: theories that propose what goes on inside your head leading to physical reactions, called psychosomatosis, are some of the most contentious areas of medicine. Such a diagnosis is based on subjective factors and is nearly impossible to prove.

It is convenient for physicians who

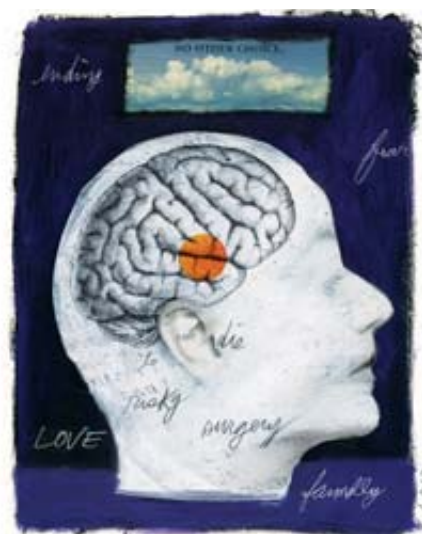
cannot figure out what is wrong with a patient to write the symptoms off as psychosomatic, especially if the person has received a similar diagnosis in the past. But symptoms that at first seem to be psychosomatic can turn out to be precursors to serious diseases and disorders. Multiple sclerosis, Parkinson's, gastric ulcers, tuberculosis and other ailments were once considered psychosomatic, until they were clearly shown to be otherwise.

Psychiatry and psychology have a long and troubled history of trying to make the psyche do far more causal work than can be justified. Such overreaching has often been in service of questionable political, economic, social or moral ideological fads. The article failed to discuss the many serious difficulties related to the notion of attributing illness to psychosomatic causes, and by not doing so, it did a grave disservice.

S.B.M. Kirby
via e-mail

NOW HEAR THIS

In the recent issue you discuss two subjects that I, as a surgeon, see as related to each other: "The Truth and the Hype of Hypnosis," by Michael R. Nash and Grant Benham, and "Can



Seemingly insensate patients may still hear the world around them.

They Hear Us?" [Head Lines] by Aimee Cunningham, about brain-damaged—but nonetheless aware—patients. The area I see connecting them is general anesthesia.

I know that posthypnotic and post-anesthetic suggestions have worked. I have told anesthetized patients they would wake up "comfortable, thirsty and hungry." After several people complained to me about their weight gain following surgery, I changed it to "hungry, but you won't finish everything on your plate."

I also saw the effect my words had on patients' ability to control body processes. Reassuring words appeared to help in diminishing bleeding, returning heartbeats to regular rhythm and restoring vital signs to normal.

Some of the most notable examples of what I think are patients responding to my words have been when I have told vegetative patients it was all right to go—and within a few minutes they did.

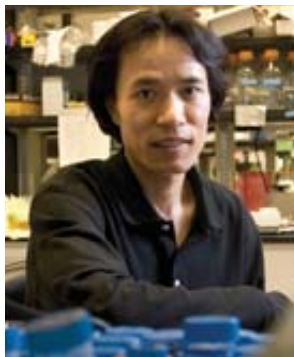
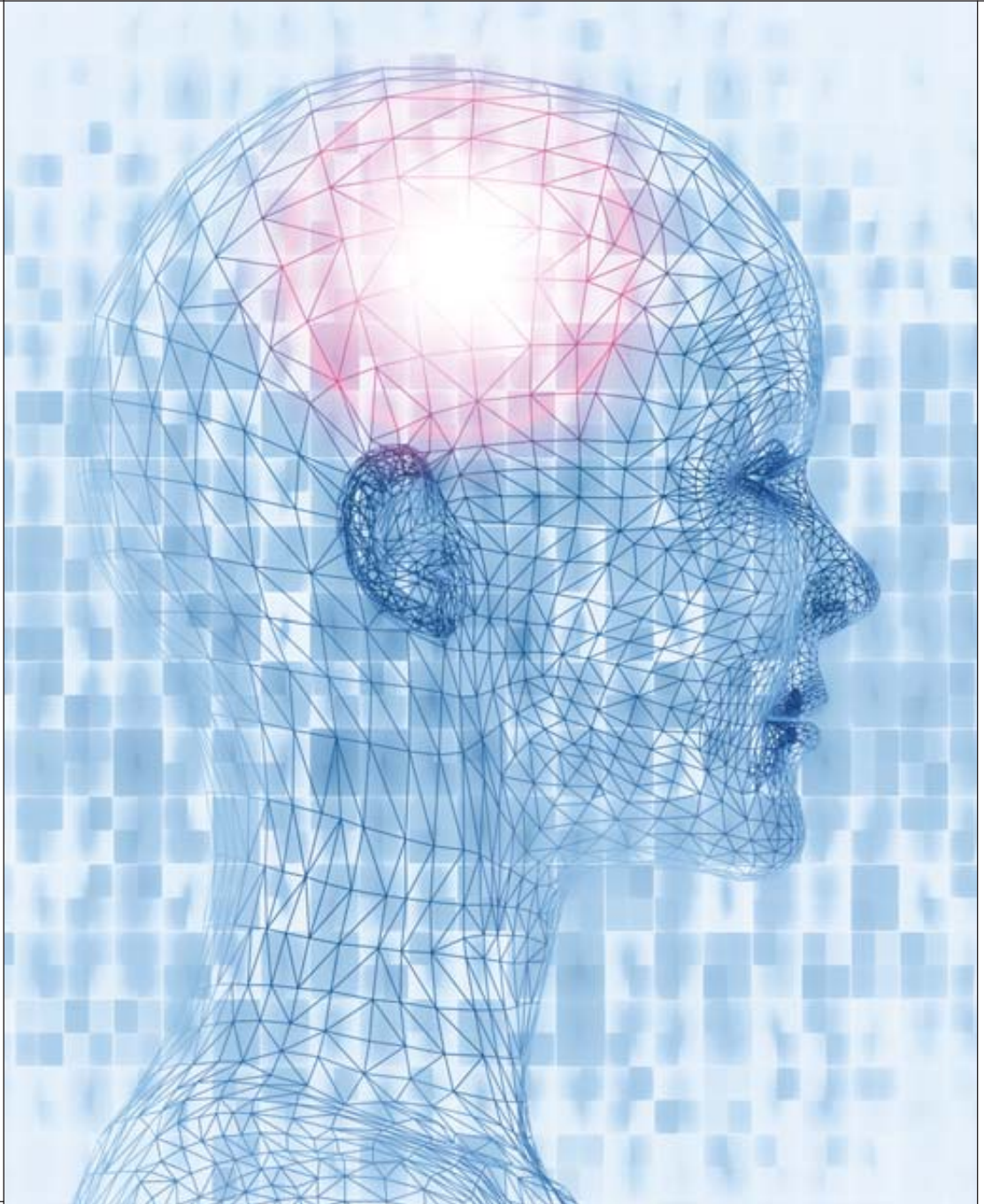
The last sense to go and the first sense to reappear during and after hypnosis and anesthesia is hearing, which makes it a powerful way to communicate with patients who otherwise appear to be unaware of their surroundings.

Bernie Siegel
Woodbridge, Conn.



Emotions and physical well-being: a problematic link?

Head Lines



Young and Evolving Brain

The human brain is still a work in progress, according to scientists who have identified two rather new variants of genes that help to govern the organ's size. A version of one gene, *ASPM*, emerged on the evolutionary scene only 6,000 years ago. The other, *microcephalin*, arose 37,000 years ago. Howard Hughes Medical Institute investigator Bruce T. Lahn (*left*) and his colleagues at the University of Chicago, who unearthed the genes, say they provide evidence that the brain is continually adapting and that there is no telling what it might look like in the far future. "We tend to think that we have reached the pinnacle of evolution," Lahn says. But these findings show that "the human brain is still changing—and rather rapidly." —Jamie Talan

GETTY IMAGES (top); JASON SMITH (bottom)

Not Mars or Venus

Men and women are not nearly as different as the media and pop psychologists would lead us to believe, according to a new metastudy of gender research.

Girls don't have the same mathematical proclivity as boys? Not true. Men can't communicate as well as women can in relationships? Not so either. And it turns out that the self-esteem problems usually associated with teenage girls are just as pronounced in teenage boys.

Of course, there are cognitive and emotional differences between the sexes, says Janet Shibley Hyde, a psychology professor at the University of Wisconsin-Madison who reviewed 46 major gender studies done over the past 20 years.

Males are indeed more physically aggressive, for example. But Hyde hopes her work reveals how we tend to concentrate on our differences instead of similarities and how we exaggerate any scientific finding



Miscalculation: girls and math.

that might unveil minor contrasts.

Humans like to categorize, Hyde explains, and once we devise categories we immediately start judging one as better than another. But there is a big social cost in getting hung up on claims that just aren't supported. "If we believe men can't communicate, what are the implications for, say, marriage?" Hyde asks. For example, why should a wife try to work things out with her husband if current culture tells her he is incapable of understanding her?

"If we say boys are better at math," Hyde continues, "we're potentially overlooking the mathematical talent of many girls." That could mean girls unnecessarily limit their own career opportunities, and it also undermines a vast talent pool for scientific and technical professions. Rather than believing pop

psychology, Hyde says, we need to listen to scientific data that "tell us when we're holding on to false stereotypes."

—Sarah Todd Davidson

Responding to Katrina Trauma

Psychologists often find it difficult to help first responders—police, firefighters and emergency medical personnel—overcome emotional scars that arise after witnessing terrible scenes of death and injury. Hurricane Katrina may have increased the complexity of post-traumatic treatment even further.

After the hurricane, emergency personnel had to work endless hours, witness people die in their arms, and stumble over drowned bodies underwater at their feet. But as many of them noted in televised interviews, what made matters far worse was feeling powerless. Trained to save lives, they had to walk past people dying on hot highways because the victims were past the point of no return and time could not be lost in finding others who still had a chance. Some police heard fellow officers' final cries for help over police radios as they drowned in raging floodwaters. At least two police officers were so distressed at their own helplessness that they committed suicide.

Experts in treating post-traumatic stress disorder (PTSD) say helping individuals cope with such

nightmares may be especially hard because, for many, the bedrock on which recovery can be built has also been taken away. Speaking on National Public Radio's program *All Things Considered* on September 20, Jeffrey Rouse, a psychiatrist at Tulane University, explained why: "The key things that are important for recovery from trauma are a lot of the psychosocial things, like good family support, continuity of socioeconomic status, your job, all the things in life that we have to buffet us." For many first responders, their homes were destroyed, family members were injured, and co-workers were missing or thought dead. —Mark Fischetti

New Orleans after the hurricane.



Schizophrenia Drugs Questioned

Donald F. Klein of Columbia University remembers handing out the first pills for schizophrenia in 1955, when the only treatment was electroshock therapy. One patient, an institutionalized war veteran who had not spoken in decades, swallowed the medication and a few days later suddenly asked, "When am I getting out of this place?"

According to a new study, this early class of drugs may work just as well at reducing hallucinations and delusions as modern pills that cost up to 10 times more. In the early 1990s the new medications, such as Zyprexa and Seroquel, took over, promising greater effectiveness and less debilitating side effects, including tremors. The federal government sponsored the \$43-million study as a check against the results of previous tests that had been sponsored by drug companies and as a way to evaluate Medicaid's payout for high-priced schizophrenia medication, one of the program's biggest expenses.

Overseen by Columbia's director of psychiatry, Jeffrey A.



Lieberman, the study randomly assigned one of five drugs—four from the new class, one from the old—to 1,460 chronically ill patients and followed them for 18 months. Lieberman's team found that all five compounds were about equally effective. And at moderate doses, at least, adverse reactions from the old medication, Trilafon, were no worse than for the others.

Perhaps the biggest surprise, however, was that none of the pharmaceuticals satisfied patients. Almost 75 percent of the participants quit treatment, were taken out by their doctors or asked to be switched to another pill, because symptoms were not improving or side effects were intolerable. "We clearly need better drugs," Lieberman says.

Although the old medications can cause tremors, stiffness and jerky muscle movements, the new medicines bring problems, too: weight gain and increased blood glucose, cholesterol and triglyceride levels, which put patients at risk for diabetes or heart disease. The rates of these side effects vary, so until better pills are actually devised, treatment may continue to be less than optimum.

—Jamie Talan

Depression Hastens Heart Disease

Scientists have known that heart patients who also suffer from depression are at greater risk for a subsequent attack. But the experts did not quite know why. Epidemiologists at Ohio State University's School of Public Health have offered an intriguing explanation. They scanned the blood of depressed and nondepressed heart patients and found that those with deflated moods are pumping out twice the level of a pro-inflammatory molecule that can damage vascular muscle.

The scientists asked 32 patients who were under care for heart failure to fill out a questionnaire that identifies depression. For patients who ranked high on that scale, one immune system messenger molecule called tumor necrosis factor alpha was almost twice as high in the bloodstream than it was for the other survey respondents. "This suggests a mechanism linking depression to heart failure," says Amy K. Ferketich, an assistant professor of epidemiology at Ohio State University and head of the investigation. She suspects that identifying and treating depression in patients with cardiovascular disease could offer greater prevention against recurring vascular problems.

—Jamie Talan



CORBIS (top); JAMES KING-HOLMES Photo Researchers, Inc. (bottom)

Blinking Turns Off the Brain

We blink an average of 15 times a minute. So why don't we notice our world repeatedly going dark?

University College London scientists used fMRI brain imaging to find out. They placed light-blocking goggles on volunteers and put a strong fiber-optic light source against the roof of subjects' mouths, which illuminated the eye through the skull. This combination created constant visual stimulation in the optic nerve and brain that



blinking did not interrupt. Yet the fMRI scans showed that each blink temporarily shut down certain parts of the visual cortex. Activity was also decreased in parts of the parietal and prefrontal regions involved in consciousness and awareness of change. The act of blinking, it seems, makes the brain blind to the interruption.

Lead scientist Davina Bristow notes that this "transient suppression" mechanism may be at work in other sensory situations. "Basically you can't tickle yourself for the same reason," she says. "When you touch yourself, as opposed to someone or something else touching you, the response [in brain activation] is lowered." —Nicole Garbarini

■ **Properly sensing** the pitch of sound helps animals interpret behavior by predators. It also helps humans distinguish a question from a statement. Recently neuroscientists at Johns Hopkins University found that in monkeys, special neurons in the auditory cortex control pitch perception. If an equivalent region is found in humans, altering it could provide therapy for individuals who have certain hearing and speech problems. No promises for people who can't carry a tune.

Smokes Are for Bad Guys

The Hollywood hero races his convertible down the boulevard for a date he can't miss. It might be with a lover or a terrorist or a CIA officer, but it probably won't involve a cigarette. A new study finds that in studio films, the most likely people to be lighting up are lower-class male villains.

Karan Omidvari, a pulmonary physician at St. Michael's Medical Center in Newark, N.J., and his colleagues watched 447 movies released after 1990 to quantify exactly who smokes on screen—an intentional scripted act. Omidvari found that the seven big companies, such as Paramount and Universal, that make up the Hollywood studio system do have a plan: villains smoked nearly twice as often as heroes; men more than women; and poor characters more than rich ones.

Why this profile exists is difficult to say, however. In movies from the 1950s and 1960s, many glamorous leading men and women smoked. Modern Hollywood films may just be reflecting U.S. population statistics, which show that lower-income people smoke more. Omidvari does not think Hollywood is shilling for tobacco

companies. He concedes that villainous characters are often popular with teenagers but maintains that it is hard to say if the propensity of such characters to smoke represents a deliberate effort to get teenagers to pick up the habit.

Interestingly, Omidvari found that independently produced R-rated films are more likely to glorify smoking—51 percent of the characters smoked, compared with



Actor John Travolta lights up in *Pulp Fiction*.

31 percent in Hollywood's R movies. If there is an attempt to influence smoking habits, "it is being orchestrated by independent movies," Omidvari says. He speculates that independent filmmakers might have more trouble raising money, and so some may accept product-placement financing. —Kaspar Mossman

■ **Gene therapy** could one day help treat Alzheimer's disease. Researchers at the Salk Institute for Biological Studies and the University of California, San Diego, were able to reduce memory loss in mice by stopping the translation of genes into a protein involved in forming plaques in the brain. It is not yet clear if the same mechanism could counter the human disease.

■ **In Britain** it is a common perception that eating cheese before bedtime gives you bad dreams. To counter this notion, the British Cheese Board asked volunteers to eat domestic cheese a half an hour before sleep each night, for a week. The next morning they recorded dreams they had. Few recalled scary encounters. Furthermore, the board reported that Lancashire cheese seemed to prompt apparitions about work, Red Leicester cheese led to nostalgic visions of childhood, and cheddar caused dreams about celebrities.

Placebo Power

Optimists are no longer alone in promoting “mind over matter.” A compelling study claims there is chemical credence for the placebo effect, at least in masking pain.



University of Michigan at Ann Arbor neuroscientist Jon-Kar Zubieta, who led the work, says that people produce a natural painkilling chemical in the brain when they expect to experience relief. Researchers gave test subjects a slow, long, harmless injection of a pain-inducing salt solution into the jaw. When the injection began, the subjects were asked to rate their level of pain. As it continued, the researchers said, falsely, that they had just added pain-relieving serum into the solution. Subjects were asked again to rank their discomfort.

Throughout the episode, subjects’ brains were scanned using positron-emission tomography. It showed that in people who said they felt less uncomfortable, particular regions of the brain produced painkilling

endorphins right after the placebo was promised. The people who expected to get relief actually produced it.

The results “open a new avenue for understanding pain as a complex experience that is moderated by a type of emotional mechanism,” Zubieta says. If the mind can induce chemical changes in the brain, psychologists and physicians could possibly devise ways to prompt natural medication through the power of suggestion. If fruitful, the approach could be tried for a variety of conditions. “The idea is to harness these mechanisms,” Zubieta explains. “Ultimately you want people to be more resilient, to have more capacity to suppress a negative experience.”
—Kyrn Haslinger

The brain releases natural painkillers when it thinks it is getting outside help.

Estrogen Blues

Over their lifetimes, women are twice as likely to suffer clinical depression than men. Low or imbalanced hormone levels can prompt depression in either sex, and insufficient estrogen in women has long been suspected. Now a comprehensive review of 30 years of research indicates that the trouble may not be low estrogen levels per se but sharp variations in those levels.

Estrogen balances often change significantly during puberty and menopause, as well as during a woman’s monthly reproductive cycle. In each circumstance, when the level shifts, a woman may experience a greater chance of depression, says Stephanie L. Douma, a researcher with Natural Resources Canada in Ottawa, who conducted the work independently. Details will be published in the February 2006 issue of *Advances in Nursing Science*.

Douma says women who are experiencing mood problems and the doctors who may treat them may not be thinking about the fluctuation scenarios and therefore may not be stabilizing estrogen at optimum levels.

The study also has implications for hormone replacement therapy, which many women undergo during or after menopause. For example, women may take hormone pills



only every third day to counter a higher potential risk for breast cancer that might be linked to too much medication. But that protocol means the hormone level never stabilizes, Douma says.

Douma hopes that the findings will prompt more investigations into best practices for regulating estrogen and that doctors will more routinely monitor their patients’ levels. These measures, she says, will help keep estrogen-associated depression at bay.
—Sarah Todd Davidson

NEO VISION Getty Images (top); ZAVE SMITH Corbis (bottom)

Many blacks believe that whites want to keep their numbers down.

Birth-Control Conspiracy?

A surprising number of African-Americans believe the government is trying to keep them in check through birth control. Public health researchers Sheryl Thorburn of Oregon State University and Laura M. Bogart of Rand Corporation surveyed 500 African-Americans across the U.S. They found that 34 percent agreed that “whites want to keep the numbers of black people down.” And 14 percent thought that “the government is trying to limit the black population by encouraging the use of condoms.”

Many of the respondents also believed government and health care organizations are lying about the side effects of birth-control methods. Together these views may make African-Americans less likely to use certain protective measures.

Although the beliefs may sound extreme, “these are things we can’t ignore,” Thorburn says, not least because condoms are effective at preventing transmission of HIV. She notes

that conspiracy fears “do not occur in a vacuum.” Early in American history, white slave owners tried to control the fertility of black women for their own profit. Government programs to encourage the sterilization of black

women persisted in back offices until the 1970s. And even though decades have passed and there is no credible evidence for a current conspiracy, African-American communities may still harbor simmering suspicion about institutional racism.

The study found that women holding conspiracy beliefs were not less likely to use birth control than others but were less likely to use the most effective methods, such as hormone pills, which involve visits to health care providers. To overcome

suspicion, Thorburn recommends that pregnancy prevention programs specifically address conspiracy beliefs. She adds that community-based groups such as churches may be most successful in spreading trusted advice.

—Kaspar Mossman



Hospital Stay Helps

Although outpatient treatment of psychiatric problems can be cost-efficient, a new study indicates that suicidal individuals treated for addiction as inpatients are significantly more likely to abstain from alcohol and drugs.

Mark Ilgen and his colleagues at the Veterans Administration Palo Alto Health Care System in California compared outcomes for addiction patients who had and had not reported suicide attempts and who were treated either as outpatients or during an extended hospital stay. All the patients had serious substance abuse problems, such as alcohol or cocaine dependence. Individuals who had reported a recent suicide attempt and were treated in the hospital did significantly better than any of the others: an 88 percent rate of abstinence from drugs six months later, compared with rates of around 60 percent for the rest.

Inpatient protocols—in this case, the average stay was 23 days—are expensive, but Ilgen notes that substance abusers who are suicidal often require several kinds of physical and mental health services again and again. “If this intensive treatment really does help them maintain abstinence over the long term, it would be cost-effective,” he says, reducing the drain they would otherwise impose on the health care system.

—Jonathan Beard



Getting Gifting

We may resent the mad dash to buy holiday presents, but they are a yardstick for relationships, and we want to measure up **BY SOPHIE CHEVALIER AND ANNE MONJARET**



BY MID-NOVEMBER store windows are bedecked with seasonal decorations of all kinds. The message is clear: the annual gift hunt has begun. In the ensuing weeks, increasing numbers of shoppers will seek the perfect items for loved ones, not to mention a little something for friends, colleagues and distant cousins.

For many people, giving is the high point of celebrations such as Christmas and Hanukkah, even though most of us hate the purchasing and wrapping hassle. So why do we persist? Social scientists say we depend on such tokens to cement new relationships and to maintain existing ones. A gift, in essence, demonstrates how much a relationship is worth and how much we are prepared to “sacrifice” for it.

Vicious Circle

Cultures around the world have vastly different gift-giving customs. But all are based on the same formula: receiving and reciprocating. Such traditions are an integral part of our relationships with family members and peers, evidenced in how central they are to occasions such as birthdays, weddings, and religious holidays and ceremonies. The primary purpose of our gift-giving systems is to affirm, or cut, social ties. An offering expresses our feelings succinctly, and yet we do not have to lay all our cards on the table or get into long personal discussions.

Frequently, however, we feel stressed by the gesture of giving. Psychologists and ethnologists theorize that the pressure does

AGE FOTOSTOCK

not stem from the nerve-racking search for the right object but rather from the exchange itself, which is a social act. Anxiety arises because of the perception and expectation that each gift, regardless of how voluntary or unnecessary, must be responded to at some point. Indeed, that expectation is again conferred with every new presentation, readily creating a vicious circle that can be difficult to escape—except, perhaps, at the cost of the relationship.

In some cases, a person may with-

Family members, friends, romantic partners—decisions must be made, and everyone is on the alert. The choice we make for a friend or partner will demonstrate whether we feel connected or whether the relationship is of lesser importance to us.

Proof in a Purchase

The act of receiving can be even harder for many people. One reason is that there is little time to compose an appropriate response. The mere thought that we did not buy a gift of at

rather use the cash to purchase something special for themselves, because that object makes visible their connection to the giver.

On the other hand, if there is a dramatic breakup of a relationship, we may have little trouble relegating old keepsakes to the attic or even tossing them out with the trash. At the symbolic level we are signaling that the departed person no longer takes up space in our emotional lives—that what is past is irrevocably finished.

In this regard, gifts represent per-

Anxiety arises because of the perception that each gift, regardless of how voluntary, must be reciprocated.

draw from the cycle, perhaps disappointed in us because we did not make a reciprocating effort to acknowledge his or her friendship or love. It can be equally uncomfortable to accept something with the knowledge that we cannot possibly give anything equivalent in return. If we allow ourselves to be in someone's "debt" instead of turning down the gift with a polite "No, thank you," giving can be wielded as an instrument of power.

As apparent as these observations seem, many people do not freely admit how much the value of a gift influences them. The two of us discovered this tendency during a recent study of adults. Our subjects admitted only reluctantly that they dig deeper into their pockets the closer their relationship is to a particular individual. The level of generosity can serve as a measuring rod.

This metric is particularly true around the year-end holidays, the quintessential celebrations of love and family. People perform a kind of calculus to match the value of their relationships with the value of the gifts they purchase. In the process they have to reevaluate their friendships and rank them—an emotional stressor by any measure.

least the same value can make us so anxious that we can barely stand it. We want so much to be seen as fair and respected gift givers.

Even though the price really should not make any difference, as soon as the wrapping is off many people take out their mental calculators. This behavior exposes the paradoxical nature of presents in our society: gifts, by definition, should not require reciprocity, but they end up being a medium of trade. By determining a value, we bring into question the fundamental nature of giving.

Small wonder, then, that so many people feel ambivalent about accepting money in particular. The individuals who participated in our study indicated that only parents should give cash to their children or grandparents to their grandchildren. Many felt it is inappropriate to send greenbacks as a birthday gift for the child of an acquaintance.

But why should coins and bills make us so uncomfortable? Presumably, because money so powerfully contradicts the notion of pricelessness. The idea that a gift has an exalted worth is the reason most people do not just spend gift money they receive on household expenses. They would much

manence. Long after we get a present, it typically means more to us than do other objects, even if we find it useless or tasteless. Would we toss out that kitschy, shell-encrusted statuette that Uncle Tommy brought us all the way from Hawaii? Of course not. That is why it is sitting on the mantle! The same goes for jewelry that may not exactly be our taste—we wear it anyway, at least when we know that the giver is likely to see it. The last thing we would want to do is rob a loved one of the feeling that his or her selection gave us pleasure.

The main lesson from all this is that we should not underestimate the significance of gifts. Many people are irritated by inappropriate offerings and may even feel insulted. We should therefore give careful thought to our giving, at any time of year but particularly during the holiday season, because the act forms one basis for our social connections—even though it has nothing to do with the holidays' true meanings. **M**

SOPHIE CHEVALIER is a lecturer in ethnology at the University of Franche-Comté in Besançon, France. ANNE MONJARET is an ethnologist at the National Center for Scientific Research (CNRS) in Paris.

False Memories

Sudden recall of forgotten childhood abuse has sent people to prison. But Elizabeth Loftus says psychologists may be planting these events in patients' heads



sial is her assertion that adults and children who have long repressed harsh memories of being sexually abused yet suddenly recall events when pressed in counseling sessions, depositions or court cases may be unwittingly fabricating the scenes. This stance has brought the prominent cognitive psychologist a great deal of trouble, but as Loftus notes in the accompanying interview, she is convinced that poor practices by therapists are indeed contributing to false memories.

—Interview by
Andreas Krauss

ELIZABETH F. LOFTUS has been researching how our memories work since the early 1970s. The professor of psychology and law now teaches at the University of California, Irvine. Quick to come from her lips is contempt for the analogy that human memory works like a computer hard disk, on which data are cleanly written and from which data are accurately read back. Loftus says our memories are routinely wrong.

Indeed, we all have forgotten where we placed our keys or blanked on a name. But that is not all. Our memories can change over time. In our mental images, we often paint ourselves in rosy colors and make the good old days nicer than they really were.

Our distortions might seem harmless except for one difficult fact: they can produce serious consequences for ourselves or others. In courtrooms, eyewitnesses who incorrectly recall the color of an accused perpetrator's shirt can send an innocent person to prison for life. Loftus's research has proved that eyewitness testimony can be flawed and that courtroom attorneys can influence a witness's memory of events. Her results have altered legal proceedings. Most controver-

MIND: How did you become interested in cases of sexual abuse?

Elizabeth Loftus: In the mid-1990s the repressed memory theory had become very popular among psychologists. Someone would know almost nothing about the fact that they were abused as a child. But the repressed experience, years later, could then cause psychological problems. Through psychotherapy it was possible—according to those who defended the repression hypothesis—to bring back the repressed memory and treat it. Based on this idea, the craziest stories were soon in circulation. Patients suddenly, and seriously, believed that they had been sexually abused in childhood. But they weren't being cured. And when all this was happening, therapists could point to no scientific evidence that the repressed memory theory was valid.

MIND: How widespread did the theory become?

Loftus: Debra A. Poole of Central Michigan University carried out a study in 1995 and found that in the U.S. and the U.K. about a fourth of all therapists were using methods that could be characterized as

dangerous: among them were hypnosis, dream interpretation, or direct demands on patients to imagine that they had been sexually abused as children. These methods are, in part, still popular today.

MIND: Why would psychotherapists want to encourage their patients to believe they had been victims of abuse?

Loftus: According to this therapeutic system, patients could not remember their traumas anymore. But as the psychologists and psychiatrists at-

MIND: You see it differently?

Loftus: When Jane was interviewed the first time, her divorced parents had already been fighting over custody of her for five years. During the legal proceedings, the father accused his former wife of having sexually abused Jane. Child Protective Services had come, at that time, to the conclusion that Jane had been neither sexually nor physically abused. In addition, the father had served time in jail [for failure to comply with visitation orders] and was therefore far from being as trustwor-

MIND: Can eyewitness testimony still be credible?

Loftus: Yes, if factors that could confound it are kept out. For example, different witnesses to a crime should be questioned privately, and the questions should be open-ended, not directed at eliciting a certain answer. When witnesses speak, they should not be interrupted by the questioner. At suspect lineups, the eyewitness should not be told who the suspect is, nor should it be suggested. The fact that memories can be influenced is something that should

Adults will insist that they got lost in a supermarket as a child, even though their parents say it never happened.

tempted to help bring memories back to life, there was an increasing chance that they would implant false memories in patients. Many therapists traced every mental problem back to sexual abuse.

MIND: Do you believe that traumatic events cannot be repressed?

Loftus: I am not saying that it does not happen. We just don't have any reliable way to determine if it has in a given individual. As long as that is true, we should avoid theories that, so far, have done more harm than good.

MIND: You investigated one such case yourself.

Loftus: Yes. In 1997 psychiatrist David L. Corwin and his colleague Erna Olafson, both then at the University of Cincinnati, published an article about a girl they called Jane Doe. According to the authors, she had been sexually abused by her mother when a child. As evidence, Corwin provided a video shot from 1984 in which Jane, as a six-year-old, described her experience. When the psychiatrist reinterviewed her 10 years later, she initially denied the abuse but then remembered it again. For Corwin, this was proof that memories could be repressed.

thy as Corwin implied. A clinical psychologist had also investigated the situation and found that it was unclear whether there really had been abuse by the mother or whether it had emerged from the imagination of the father, who then may have fed it all to Jane, who made the allegations.

MIND: Perhaps the way Jane was interviewed affected her stories. Can suggestive questioning influence memories?

Loftus: The effects can be amazing. In research studies, we have been able to convince adult volunteers that they got desperately lost in a supermarket as a child, even though their parents tell us it never happened. Many of the subjects even invent details to make the story more dramatic.

MIND: Some colleagues say such experiments are not comparable to repressed memories of abuse.

Loftus: These people are trying to discredit my research because it undermines the foundations of their worldview. But our memories are malleable—whether we apparently got lost in a supermarket as a kid, were supposedly sexually abused or, as witnesses at a trial, wrongly remember the color of the getaway car.

be explained, repeatedly, to both judges and jurors.

MIND: Can real and false memories be distinguished later?

Loftus: Not reliably. Real memories are usually more detailed. But the more often false memories are explicitly formulated, the livelier they become, and they thus seem more credible.

MIND: What would you advise therapists—and patients—to do?

Loftus: A therapist should not start out with the assumption that repressed sexual abuse is the only possible explanation for psychological problems. He or she should consider other causes. And they should remain aware of the power of suggestion in their own actions. If I were a patient, I would hasten to get a second opinion if my therapist seemed to employ dubious methods.

MIND: Where is your research directed right now?

Loftus: False memories can be deliberately implanted. But do they have long-lasting influence on our behavior? We are looking into this question. **M**

ANDREAS KRAUSS writes about science from Heidelberg, Germany.

Hidden in Plain Sight

Camouflage in fish and other animals provides insights into visual perception

BY VILAYANUR S. RAMACHANDRAN AND DIANE ROGERS-RAMACHANDRAN

ONE OF THE MAIN FUNCTIONS of visual perception is to detect objects in the environment as a prelude to identifying them as prey, predators or mates. Not surprisingly, both prey and predators go to enormous lengths to conceal their physical boundaries by blending in with the color and texture of their surroundings. Indeed, we can almost think of higher visual processing in the brain as having mainly evolved to defeat camouflage. Studying the strategies of camouflage can therefore indirectly also tell us a great deal about the mechanisms of vision.

American painter and amateur naturalist Abbott Handerson Thayer speculated that animals developed “protective coloration.” As his theory held, “animals are painted by nature darkest on those parts which tend to be most lighted by the sun’s light, and vice versa.” He was surely right about this effect (scientists now call it “countershading”). But then he went on, even suggesting that peacocks’ tails match foliage and that flamingos are pink to allow them to blend in with the sunset (a)!

To modern scientists, Thayer obviously got a bit carried away. Yet as the saying goes, “fact is stranger than fiction.” Some animals, such as cuttlefish, octopuses and flounder, can alter their markings and hues to suit whatever surface they happen to land on. Although chameleons are often credited with this skill, they are actually quite bad at it; most of their color changes are reserved mainly to attract mates and protect their territories and are thus unrelated to camouflage.

Biologist Francis B. Sumner, one of the founders (but not the sole flounder) of the Scripps Institution of Oceanography, showed nearly a century ago that cold-water flounder have an amazing capacity to match the “graininess”



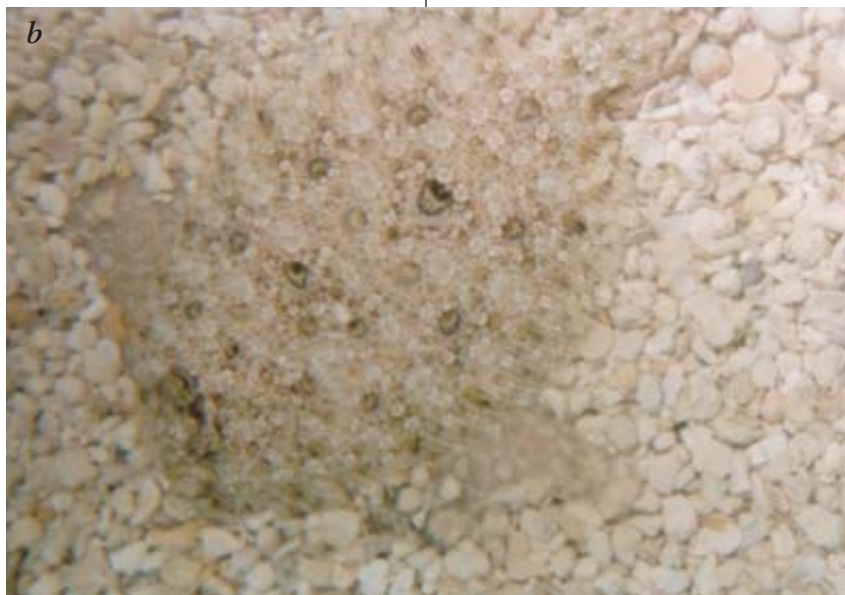
of their skin surface markings with gravel or pebbles in their background. Sumner’s work was supplemented by the experiments of S. O. Mast, who in the early 20th century showed that the matching depends on vision; blinded flounder do not change.

Sumner’s findings made a big splash when he published them. But they were later challenged by neurobiologist William M. Saidel, now at Rutgers University at Camden. Saidel claimed that the markings on flounder changed only slightly but that they had a kind of “universal” texture that allowed them to blend in with most backgrounds. So, he argued, in a sense it was the viewer’s

eye that was doing the blending—not the flounder itself.

Cold-water flounder live in a rather drab, monotonous sandy environment. It occurred to us that this fact could account for the poor show put on by Saidel’s flounder, which would not have had the evolutionary pressures to adapt to a greater range of backgrounds; unlike the cold-water locations, the tropical environment contains more varied surfaces. In collaboration with Christopher W. Tyler, Richard L. Gregory and Chandramani Ramachandran, we therefore decided to experiment with the tropical reef flounder *Bothus ocellatus*, commonly known as the eyed flounder.

We obtained six specimens from an aquarist. After the fish had adapted to a “neutral,” beige-colored fine gravel floor in a holding tank (b), we moved them into small experimental tanks that each had different patterns on their floors. We selected patterns that, though not found in nature, would clearly demonstrate the limits of the fish’s ability to adapt actively, or dynamically,



JAKE WYMAN Getty Images (a); V. S. RAMACHANDRAN (b, c and d)

(We realized that there must be a neural “reflex” at work.
The reaction was too fast to be hormonal.)

to their surrounding environment.

The results were remarkable. In every case, the fish were able to achieve an impressively good match when “plaiced” on various backgrounds of coarse check patterns (*c*), medium and fine checks (*d*), pebbles (*e*, *next page*) or fine gravel. Even more startling, we found that the fish transformed in just two to eight seconds—not the several minutes that Mast and Sumner had implied. We knew then that there must be a neural “reflex” at work. The reaction was too fast to be hormonal.

The fish’s eyes, we determined, must be getting a highly foreshortened, distorted view of the background, given their vantage point at the bottom and the distortions of its optics. The fish have turretlike eyes mounted on stalks, with which they quickly scan the surrounding floor texture. Our colleagues are often very puzzled that the fidelity of matching is so precise given these distortions. But this conformity is no more unexpected to neuroscientists like ourselves than is the fact that we do not see the world upside down, even though the retinal image is. Because no actual cinema screen with a

picture exists in the brain, the question of “correction” does not even arise; the brain encodes visual information in such a way that the correction for a flawed or noisy sensory input is already implied in the code itself. In much the same way, the fish’s brains must make adjustments so that the camouflage pattern is produced accurately.

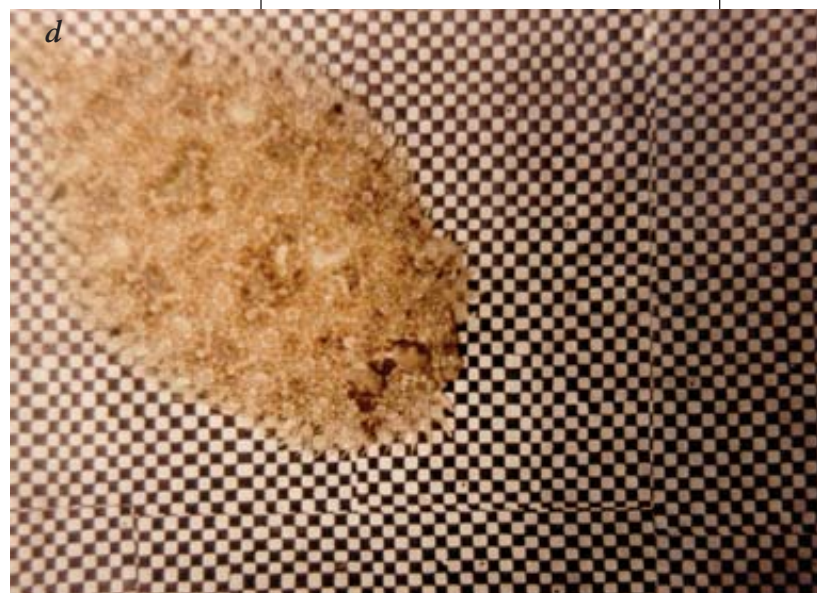
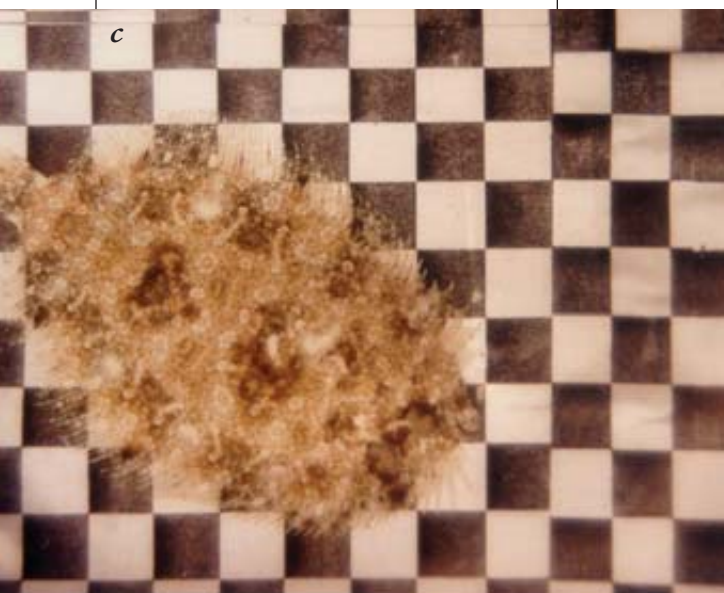
How do the fish achieve such dynamic camouflage? Examination through the dissecting microscope revealed that the skin has clusters of cells containing the dark pigment melanin, called melanophores. By varying the dispersal of melanin pigment granules in these cells, the fish can alter the contrast of small patches of skin. In addition, we saw what appeared to be at least four classes of clusters of different sizes and a single isolated cluster on the middle of the fish. By independently varying the contrast of these four types of clusters—a bit like dialing up the contrast knob on an old television set—the fish can vary the *ratio* of different pixel types and achieve a reasonable facsimile of the most commonly encountered textures on the ocean floor where they live. This

system is analogous to the manner in which one can use just three “primary” wavelengths in various ratios to produce any conceivable color that the eye can see. By analyzing the the pattern on the fish and corresponding background with a mathematical technique called principle component analysis, we were able to establish that the fish have independent visual control of each set of markings.

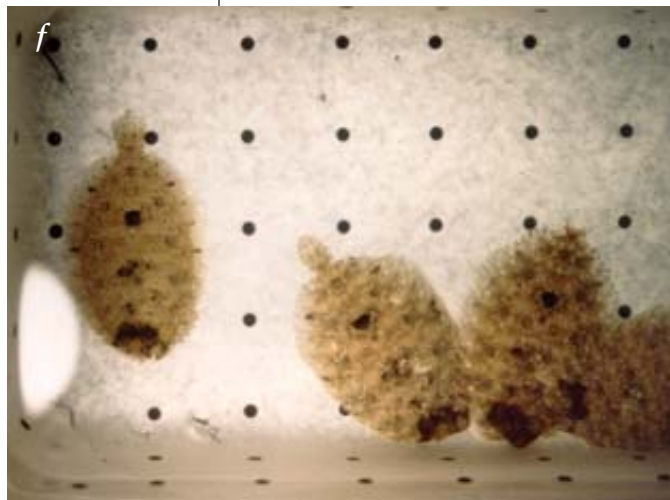
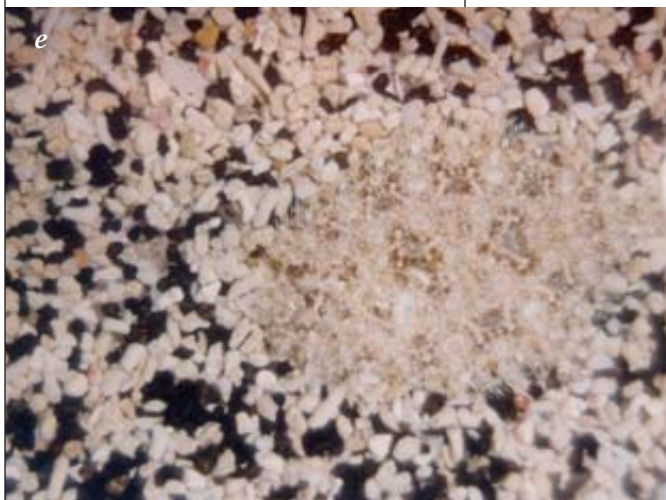
Just for the halibut, we tried putting the fish on a background of polka dots. Amazingly, their entire skin went pale and became homogeneous except for one small conspicuous black dot right on the center of the body (*f*, *next page*). The fish were making a valiant attempt to match the polka dots! See if you can spot the fish in the photograph.

Flounder also use other visual tricks to deceive predators. When we approached one menacingly with an aquarium net, it would move forward and stir up the sand, “pretending” to bury itself in one location while it actually retreated at lightning speed and buried itself elsewhere.

Squid, cuttlefish and octopuses (*g*, *next page*) are also masters of camou-



Octopuses can **distort their forms** to mimic various poisonous sea creatures, such as snakes and lionfish.



flage. Yet instead of dispersing pigments, they simply open or close opaque “shutters” across skin patches. Even more intriguing, they match not only the color and texture of the background but the *shapes* of objects in the vicinity as well (*h*)—as elegantly shown by Roger T. Hanlon and his colleagues at the Marine Biological Laboratory in Woods Hole, Mass. Octopuses can distort their forms to mimic various poisonous sea creatures, such as snakes and lionfish. The mechanism is not known. Nerve cells—called mirror neurons—have been identified in the brains of primates that may be involved in mimicry of the postures and actions of others. We suggest that analogous cells have evolved in the brains of cephalopods through convergent evolution—which would be astonishing given that vertebrates diverged from invertebrates over 60 million years ago.

Figuring out the mechanisms of dynamic camouflage in flounder may have obvious military applications. Taking a lesson from the fish, the military could use a small number of changing pigmented splotches to “match” a

tank to its background far better than a static paint scheme. Such experiments, far from being just a fishing expedition, can give us vital clues about the evolution of visual perception. **M**

VILAYANUR S. RAMACHANDRAN and DIANE ROGERS-RAMACHANDRAN are at the Center for Brain and Cognition at the University of California, San Diego.

(Further Reading)

- ◆ **Rapid Adaptive Camouflage in Tropical Flounders.** V. S. Ramachandran, C. W. Tyler, R. L. Gregory, D. Rogers-Ramachandran, S. Duensing, C. Pillsbury and C. Ramachandran in *Nature*, Vol. 379, pages 815–818; February 29, 1996.
- ◆ **Mirror Neurons.** Vilayanur S. Ramachandran. Available at www.edge.org/3rd_culture/ramachandran/ramachandran_p1.html
- ◆ Information about adaptive camouflage is available at Roger T. Hanlon's site at the Marine Biological Laboratory, Woods Hole, Mass.: www.mbl.edu/mrc/hanlon

(calendar)



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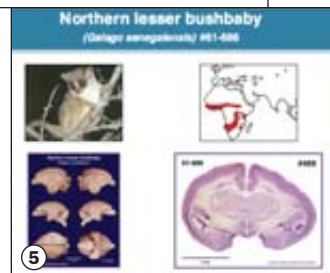
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3



4



5

EXHIBITIONS

1 Brain: The World Inside Your Head

Walk through an enlarged brain, complete with lightning shows that imitate the central nervous system—just one part of a 5,000-square-foot interactive traveling exhibit.

The Science Place, Dallas

Through Jan. 8, 2006

214-428-5555

<http://scienceplace.org>

2 Body Worlds: The Anatomical Exhibition of Real Human Bodies

The brains and nervous systems of several real human bodies appear in three-dimensional exploded views. Gunther von Hagens preserved the bodies in plastic and dissected them for display, sometimes in shockingly unusual ways.

The Franklin Institute, Philadelphia

Through April 23, 2006

215-448-1200

<http://sln.fi.edu>

The Logic Puzzle Museum

Play with 50 different hands-on brain twist-ers and mechanical and logic puzzles.

The Logic Puzzle Museum, Burlington, Wis.

Ongoing exhibits

262-763-3946

www.logicpuzzlemuseum.org

MEETINGS

3 The Psychology of Health, Immunity and Disease Conference

Medical and mental health professionals converge for discussions of mind/body/spirit, sponsored by the National Institute for the Clinical Application of Behavioral Medicine. Sessions include "How Can I Forgive You? A Radical Approach to Healing Intimate Wounds" and "On Becoming an Artist: Reinventing Yourself through Mindful Creativity."

Hilton Head, S.C.

Dec. 5-11

860-456-1153 or 800-743-2226

www.nicabm.com

The Fifth International Conference on Neuroesthetics

The name of the Web site says it all: *plaisir* is French for "pleasure." Neuroesthetics is the study of how our brains appraise beauty, flavor and harmony.

University of California, Berkeley

Jan. 21, 2006

510-847-2191

<http://plaisir.berkeley.edu>

Winter Conference on Brain Research

Clinical psychologists meet molecular neurobiologists in a free exchange of ideas. In past years lecturers have covered topics such as "What's Up with Ecstasy?" and "The Mind's Big Bang: Only 50,000 Years Ago."

Steamboat Springs, Colo.

Jan. 21-27, 2006

217-333-2880

www.conferences.uiuc.edu/conferences

American Psychoanalytic Association Winter 2006 Meeting

The organization, devoted to psychoanalysts, has about 3,200 members across the country.

New York City

Jan. 18-22, 2006

212-752-0450

www.apsa.org/programs/meetup.htm

MOVIES/TV

4 Wired to Win: Surviving the Tour de France

The subject of this 40-minute IMAX documentary is how the human brain can power us to incredible achievements, such as winning the Tour de France. Combining personal stories and computer graphics, the film follows riders as they grind over the high passes of the Pyrenees and then race through the perilous descents to the finish line in Paris, explaining how our minds can sustain us through extreme hardship to victory.

PD Productions (distribution by nWave Pictures)

Opening Dec.

www.wiredtowinthemovie.com

The Ringer

Steve Barker, a man of dubious integrity but good intentions, attempts to rig the Special Olympics to help out his uncle and his friend. Pretending to be intellectually disabled, he enters the competition. His fellow Olympians see him for what he is but conspire to help him win in order to dethrone Jimmy, the arrogant reigning champion.

Fox Searchlight Pictures

Opening Dec. 23

www.foxsearchlight.com/theringer/

WEB SITES

www.mindhacks.com

Do you think you might suffer from post-traumatic stress disorder? Wonder how you would feel if you couldn't prove you weren't an Internet chatbot? In this blog, Tom Stafford and Matt Webb, authors of the book *Mind Hacks*, keep you up-to-date on the latest ways you can look inside your own mind.

www.algy.com/anxiety

tAPir, the Anxiety Panic Internet resource, is a self-help Web site for those who suffer from anxiety disorders, as well as an information center for anyone who wants to learn about depression or phobias and how to improve his or her outlook on life.

5 www.brainmuseum.org

Images and information from one of the world's largest collection of preserved, sectioned and stained brains. Browse and download photographs of brains of more than 100 different species of mammals (including humans).

www.oliversacks.com

Oliver Sacks, professor of neurology at Albert Einstein College of Medicine in New York City, is the author of such fascinating books as *Awakenings* and *The Man Who Mistook His Wife for a Hat*. His home page includes a biography, a lecture schedule and an intriguing set of FAQs.

Send items to editors@sciammind.com

PICTUREIMPERFECT

Like a flawed painting, our self-image suffers from poor perspective: we consistently overestimate our skills and overlook flaws

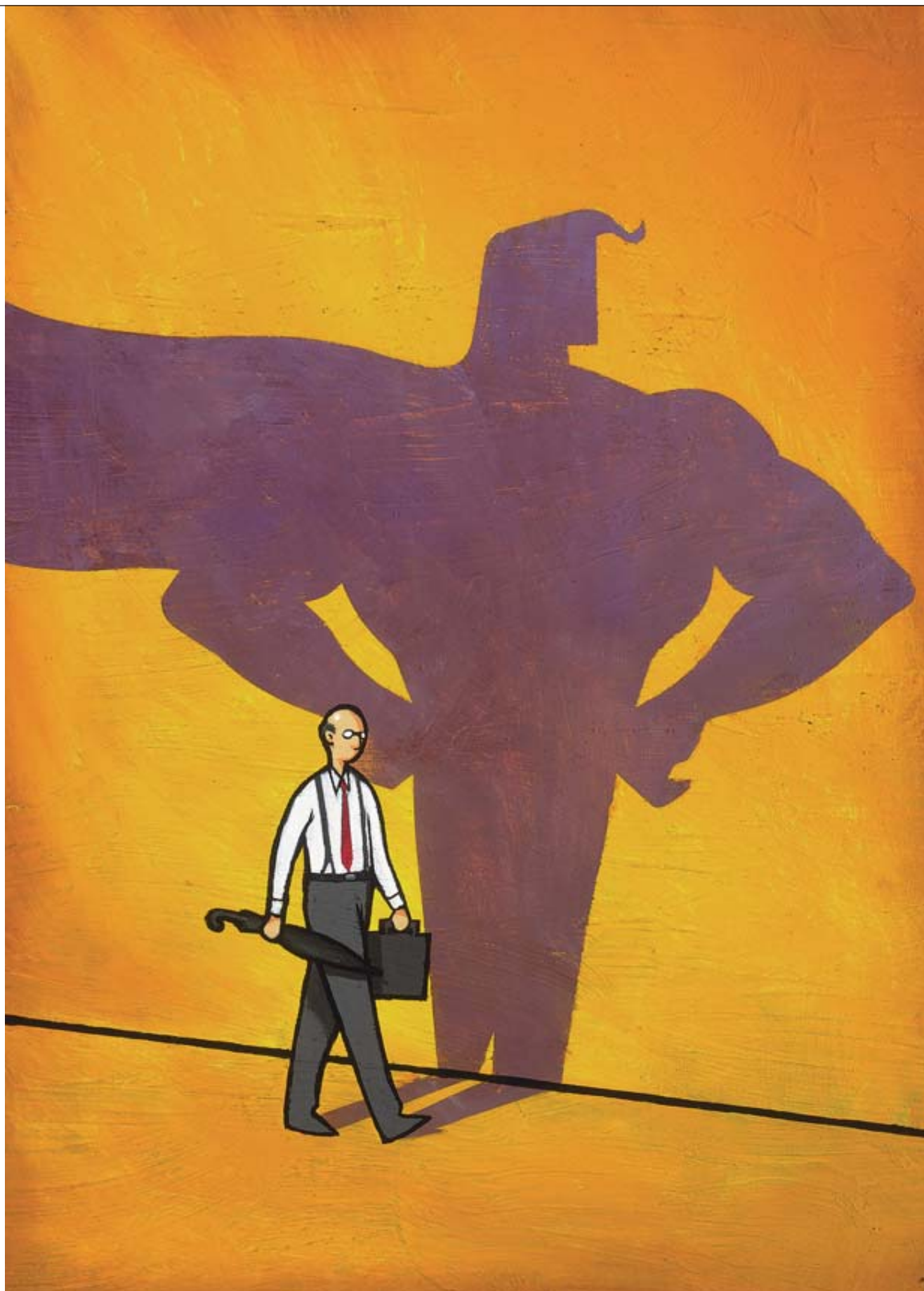
By David Dunning, Chip Heath and Jerry M. Suls

*There are three things extremely hard: steel,
a diamond, and to know one's self.*

—Benjamin Franklin

A teenage violinist applies to music school based on her notions of her musical virtuosity. A military officer volunteers to command a dangerous mission because he is confident about his bravery, leadership and grace under pressure. A healthy elderly woman decides not to get a flu shot because she feels that it is unlikely she will fall ill.

Over their lifetimes, people base thousands of decisions on the internal pictures they hold of their own skills, knowledge, personality and moral character. During decades of research, psychologists have examined just how accurate these self-perceptions are in a wide variety of tasks and circumstances. In study after study, researchers find that self-ratings of aptitude



hold only a tenuous to modest relation, at best, with actual performance—indeed, other people can often foresee an individual’s outcomes better than that person can. Individuals also overrate themselves. As a consequence, the average person claims to be “above average” in skill—a conclusion that, in aggregate, defies statistical possibility. He or she also overpredicts the likelihood of engaging in desirable behaviors and achieving favorable outcomes, furnishes excessively optimistic estimates of when he or she will complete future projects, and reaches judgments with too much confidence. The findings have important consequences for health, education and the workplace [see boxes on pages 23, 24 and 26–27].

Swelled Heads

How far off are self-judgments? People’s notions about their intelligence tend to correlate only 0.2 to 0.3 with performance on intelligence tests and other academic tasks. (Correlation measures the direction—positive or negative—and extent—from +1 to –1—of the relation between two scores. For example, the correlation between gender and height is roughly 0.7.) College students’ ratings of academic self-efficacy during their first year correlate only 0.35 with their instructors’ evaluations. In the workplace, the correlation between how people expect to perform and how they actually do hovers around 0.20 for complex tasks.

People in some domains do better than others. In athletics, where critiques from coaches and

visor’s ratings are strongly related, as are the ratings of their peers who are equally inexperienced. And in a 1991 study by Bernard M. Bass and Francis J. Yammarino of Binghamton University, peer ratings of leadership, rather than self-ratings, predict which naval officers will be recommended for early promotion.

People also show in many different ways how they hold inflated views of their expertise, skills and character. Consider the tendency for the average person to see himself or herself as above average. In a 1976–1977 College Board survey of nearly one million high school seniors, 70 percent claimed to have above-average leadership skills, and only 2 percent gave themselves below-average marks. On their ability to get along with others, almost all respondents rated themselves as at least average—with 60 percent rating themselves in the top 10 percent of this ability and 25 percent rating themselves in the top 1 percent.

Students have no monopoly on such “above-average effects.” Motorcyclists believe they are less likely to cause an accident than the typical biker. Business leaders believe their company is more likely to succeed than the average firm in their industry.

Individuals also demonstrate inflated estimates of self when they assess how quickly they will complete tasks, a phenomenon known as the planning fallacy. For example, Roger Buehler of Wilfrid Laurier University in Ontario and his colleagues reported in a 1994 study that college students take three weeks longer to finish their

(The average person claims to be “above average”—an idea that defies statistical possibility.)

others who have an “outside” perspective tend to be constant, immediate and unambiguous, the typical correlation is 0.47. In the realm of complex social interactions, however, where feedback might be occasional, often delayed and ambiguous, it tends to be much lower—for instance, just 0.04 for self-assessment of managerial competence and 0.17 for interpersonal skills.

Acquaintances may predict a person’s performance in some situations *better* than the person himself or herself can. As Donald A. Risucci of New York Medical College and his colleagues put forth in a 1989 study, although the self-views of surgical residents are not related to their performance on standardized board exams, their super-

senior thesis than the most “realistic” estimate that they give for the task—and one week longer than what they describe as their “worst case” scenario. In a similar vein, in 1997 Buehler, Dale W. Griffin of the University of British Columbia and Heather MacDonald, then at Simon Fraser University in Burnaby, B.C., found that citizens typically believe they will complete their tax returns more than a week sooner than they actually do.

Indeed, even when people are most confident, that conviction is no guarantee of accuracy. In 1977 studies by Baruch Fischhoff of Carnegie Mellon University, Paul Slovic of the University of Oregon and Sarah Lichtenstein, then at Decision

Lessons for Education

Like most people, students tend to be overconfident about newly learned skills. This self-assessment problem can occur because the common educational practice of “massed training” promotes rapid acquisition of a skill—and self-confidence—but not necessarily the retention of that capability. In massed training, instructors teach students in one or a few intense sessions. Students undergoing such instruction quickly obtain the relevant knowledge. Yet skills taught in this fashion tend to decay rapidly, although people remain unaware of this fact. Nowhere might this problem be more evident than in driver education. Although millions of dollars are spent on such courses, they do not, the data suggest, produce safer drivers.

Rather retaining knowledge and skills requires a different recipe: “spaced” or “distributed” training, in sessions that are divided over several occasions—even though this practice means that students initially learn more slowly and with more difficulty. In addition, recent research points to ways to correct flawed self-assessment in students. For example, some scholars have proposed that certain forms of driver education might do more harm than good, making novices unduly confident about their ability to handle difficult driving situations. As a substitute, drivers might instead undergo “overconfidence training,” in which students are shown just how difficult it is to handle adverse road conditions, so that they proceed more carefully—or just stay home when it is wiser to do so.

—D.D., C.H. and J.M.S.



Research in Eugene, Ore., a center for decision-making research, college students who expressed 100 percent certainty in their answers were still wrong roughly one time out of every five. In a 1981 study, when doctors diagnosed their patients as suffering from pneumonia, predictions made with 88 percent confidence turned out to be right only 20 percent of the time, according to Jay Christensen-Szalanski of the University of Iowa and James B. Bushyhead of Minor & James Medical, a group practice in Seattle.

What Goes Wrong?

A wide variety of psychological mechanisms underlie these flawed self-assessments, and it would be difficult, if not impossible, to catalogue them all in a single article. Yet if we confine ourselves to two of the most widely documented biases—above-average effects and the overprediction of desirable events—we can describe two general underlying themes. The first is that people typically do not possess all the information required to reach reliably accurate self-assessments. Too many factors are unknown, unknowable or even undefinable for people to make accurate

evaluations of self-performance or forecasts about how they will act in the future. Second, in those cases where valuable information that would help guide toward appropriate self-evaluations is in hand, people often neglect that information or give it too little weight, thus leading them toward error.

Consider, first, the above-average effect. People often do not have the knowledge and expertise necessary to adequately assess how their competence stacks up against that of their colleagues—and the most incompetent are frequently the most prone to err in their personal judgment. Incompetent individuals suffer a double curse: their deficits cause them to make errors and also prevent them from recognizing what makes their decisions erroneous and the choices of others superior.

Several studies have now demonstrated that incompetent individuals fail to show much insight into their deficiencies. College students scoring in the bottom 25 percent on a course test routinely walked out of the exam room thinking they had outperformed a majority of their peers, according to a study by one of us (Dunning), Justin Kruger

Playing Doctor

Flawed self-assessment makes people unrealistically optimistic about their own health risks versus those of others. Guided by mistaken but seemingly plausible theories of health and disease, poor health decisions can have severe consequences for individuals' well-being and longevity.

When people feel that they are relatively invulnerable to flu, they are less likely to think about obtaining a flu shot. Those who believe their chances of being affected are lower than that of their peers are more likely to engage in high-risk sex and less likely to use contraception. Some patients suffering from high blood pressure believe they can tell when their pressure is high and so take their medication accordingly, even though there are no actual symptoms that indicate when pressure is high or low. And so they should take their medication as prescribed and without fail.

Two techniques reduce such unrealistic optimism. One is personalized feedback. In a 1995 study Matthew Kreuter of Saint Louis University and Victor Strecher of the University of Michigan at Ann Arbor asked patients to complete a questionnaire about their perceived and actual risk of 10-year mortality from heart attack and stroke. To measure the perceptions, the researchers asked patients to rate their degree of risk ("higher than others," "average" and so on). Actual risk was assessed with questions about age, height, weight, blood pressure and other factors. Risk-estimation algorithms then calculated each patient's actual risks. Two to four weeks after completing the baseline questionnaire, participants received mailed feedback about their actual risk compared with that of others of the same age and sex. Six months later



results from a follow-up questionnaire indicated that patients who were initially unrealistically optimistic about stroke risk had become more realistic after the receipt of personal risk information. Personalized risk feedback thus may be helpful when there is direct contact with the individual, as when a patient visits a doctor.

The second technique targets the motivational basis of unrealistic optimism. Confront people with bad risk information, and they will defend their worldview against the data. Yet if their sense of self-worth is bolstered before they encounter that information, they become more willing to accept it and to change behavior. In a 2000 experiment by David Sherman, Leif Nelson and Claude Steele, all then at Stanford University, college students who wrote about a personally important value (such as how much they cared about friends and family) before viewing an AIDS awareness film were more affected by the message. Relative to a control group, they viewed themselves as more in danger and took a greater number of condoms as they left the laboratory.

—D.D., C.H. and J.M.S.

and Kerri L. Johnson, both at New York University, along with Joyce Ehrlinger of Cornell University. In a 2001 study at the University of Toronto by Brian D. Hodges and Glenn Regehr, medical students mishandling a mock interview with a patient rated their interviewing skills much higher than their instructors did.

In addition, missing information feeds overprediction of good performance. By definition, people are not aware of solutions they could have generated but missed—that is, their errors of omission. For example, suppose we asked you to make as many English words as you can from the letters constituting the word "spontaneous" ("tan," "neon," "pants" and so on), and you find 50. Whether this number is good or bad depends,

in part, on how many words can actually be found in "spontaneous," and it is difficult to expect anyone to have an accurate intuition of what that figure is. In fact, the letters in "spontaneous" can spell more than 1,300 English words.

In the absence of complete feedback, people can harbor inflated views about the wisdom of their actions. Suppose an office manager takes a poorly performing employee aside and chews him out. The next day that employee does better—providing evidence for the sagacity of the office manager's intervention. Yet the manager does not know what might have been achieved by other alternatives, such as sitting down with the employee for a sympathetic talk or even doing nothing. Maybe these alternatives would have

worked as well, or even better, but the manager will never know.

Perhaps most fundamentally, success in certain spheres is harder to define than in others. As a consequence, people regularly believe themselves to be above average on traits that are ill defined but not on ones whose definition is narrower. For example, as Dunning, Judith A. Meyerowitz and Amy D. Holzberg, then all at Cornell, found

have all the information they need to make more accurate forecasts. But more than that: individuals often cannot hope to have all the information they need—and thus they should proceed with caution whenever making a prediction about their future behavior. If someone walked up to you on the street to ask you to donate money to a charity, would you do it? Your actual behavior depends on any number of situational features

People also misjudge their skills in relation to others by ignoring crucial information.

in 1989, people may say that they are more sophisticated, idealistic and disciplined than their peers (ambiguous traits, all) but not that they are any more neat, athletic and punctual (traits that are more constrained in their meaning).

Although humans naturally like to see how they stack up, people also misjudge their skills in relation to others by ignoring crucial information or by focusing exclusively on themselves. When evaluating their skill vis-à-vis their peers, individuals are egocentric, thinking primarily of their own behaviors and attributes and ignoring those of others, according to Kruger. Thus, people's comparative judgments often paradoxically involve very little actual comparison. Ask them how well they can ride a bicycle compared with other cyclists, and they say they do so quite well—mostly dwelling on how they have no trouble riding but forgetting that others have no difficulty, either. But ask them about their juggling ability, and they describe themselves as worse than average—neglecting again that others are also lousy jugglers.

This egocentrism leads people to make irrational choices. College students, for example, prefer to compete with others in a trivia contest focusing on Adam Sandler movies (an easy subject for them) than to compete in one on 19th-century French painting (a hard topic), forgetting that what is easy or difficult for them probably would be equally easy or difficult for their competitors. People bet more in poker games with a large number of wild cards in the deck because they are more likely to have a good-looking hand. But wild cards do not play favorites, and other players are equally advantaged as the number of wild cards expands.

Mispredictions of the future, usually overoptimistic ones, also arise because people do not

you are not in a position to know until you are actually in the moment. Does the person asking look meek or menacing? Do you have time, or are you late to an appointment? Is it sunny or raining? Do you have any small bills in your pocket? Is the charity one you respect? Any of these details can influence whether you give or not, but you do not know which details will turn out to be true until you finally face the situation for real. People make overly confident predictions about their future behavior because they fail to correct for the fact that such important details of future situations are often unknown or unpredictable.

People may also have difficulty predicting how they will respond to circumstances that have significant emotional or visceral components. For example, office workers approached just after lunch predict that the next week at 4 P.M. they would prefer to receive a healthy snack, such as an apple, rather than some junk food, even though they know (intellectually) that they tend to be hungry late in the afternoon. When next week arrives, they in reality tend to prefer the calorie-laden junk food over the healthy fruit that they predicted they would want, as reported in 1998 by Daniel Read of the London School of Economics and Political Science and Barbara van Leeuwen, then at Leeds University Business School. In short, men and women fail to ade-

(The Authors)

DAVID DUNNING, CHIP HEATH and JERRY M. SULS wish they had the gift of perfect self-assessment. Dunning is professor of psychology at Cornell University. Heath is professor of organization behavior at the Stanford Graduate School of Business. Suls is professor of psychology at the University of Iowa. This article is adapted from a more comprehensive technical report published in *Psychological Science in the Public Interest* [see "Further Reading," on page 27].

Tough Job

In the workplace, flawed self-assessments arise all the way up the corporate ladder—and, indeed, can be most noticeable at the top levels, where accurate feedback is difficult to come by.

Employees typically overestimate their skills, because it may be difficult for them to learn about how they are truly performing. Managers may also avoid giving reviews, because doing so can be unpleasant. In turn, workers may not seek criticism for fear of receiving a blow to their self-esteem or appearing insecure or needy. Last, the reviews themselves tend to be relatively ineffective because they are infrequent, threatening or sugarcoated.

Various solutions have been proposed. Some argue that feedback (“coaching”) should be separated from evaluation and that pointers should be given more frequently. But in a busy organization, asking for informal coaching multiple times a year might be asking a lot. Others advocate taking the burden off one manager—for instance, by using “360-degree reviews,” in which an individual may be appraised by peers, subordinates and multiple superiors. Yet this procedure is more costly and intense.

How, then, can organizations recognize and develop top employees without undermining the motivation of the majority in the middle? One way might be to highlight a few exceptionally good and bad performers and give the rest an ambiguously positive evaluation (*graph at right*).



Aside from fine-tuning reviews, corporations can build in fail-safe measures to make up for overconfident employees. For instance, software developers often underestimate how long it will take them to deliver new software. Microsoft, thus, automatically builds in a 30 to 50 percent additional buffer time. Microsoft also helps developers assess their own self-knowledge by breaking a complicated project into concrete, manageable chunks. In a 1995 study by Michael Cusumano of the Massachusetts Institute of Technology and Richard Selby, then at the University of California, Irvine, one manager explains: “The classic example is you ask a developer how long it will take him to do something, and he’ll say a month, because a month equals an infinite amount of time. And you say, ‘Okay, a month has 22 working days in it. What are the 22 things you’re going

quately anticipate how emotional or visceral factors (such as hunger) will influence their behavior if they are not feeling those factors at the moment they make their predictions. Thus, when they are in a “cold” (logical) state, they mispredict how they will react when in a “hot” (emotional or visceral) state.

Getting the Picture

Can we get a better perspective on ourselves? One general solution is to consciously take what is called the “outside view” rather than an “inside” one. People adopting an inside view focus on the “internal” dynamics of a situation as well as their own personal dynamics and then spin a story of what they are likely to do or accomplish in a given situation. Adopting an outside view means setting aside storytelling and focusing instead on data. When predicting what they are likely to do in the future, they should simply ask

themselves what they have tended to do in the past, as well as take into account what has happened to others who have faced similar situations. For example, in one study students were asked to estimate when they would complete an academic task, and they guessed that they would complete it about four days in advance of the deadline (a goal that only about 30 percent achieved). Yet when asked when they had typically accomplished such tasks in the past, they admitted that they usually finished only one day before the deadline—and this time frame turned out to hold true for the project they were predicting. Similarly, a random sample of Canadian taxpayers thought that *this year* they would mail in their return about a week earlier than usual—but they generally completed their returns about when they had in previous years.

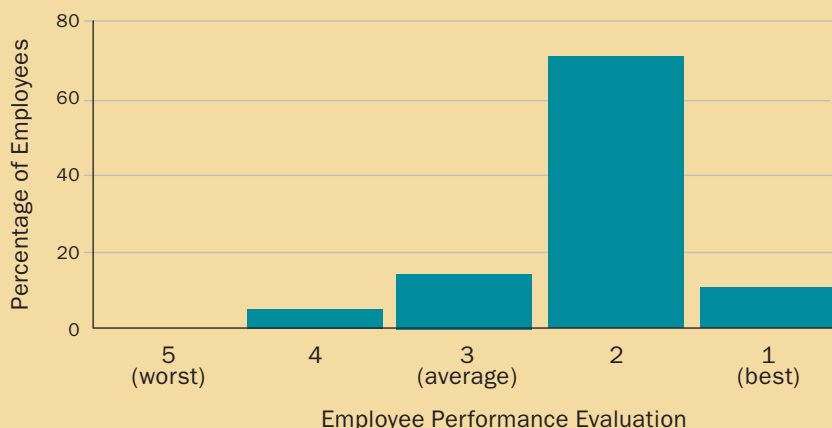
In a telling 2003 study Daniel Lovullo of the University of New South Wales in Australia and

CORBIS

to do during those 22 days?’ And the guy will say, ‘Oh, well, maybe it will take two months.’ Even by breaking it down into 22 tasks, he realizes, ‘Oh, it’s a lot harder than I thought.’”

CEOs illustrate the problems of overconfidence in the starkest form. Sitting at the top of a hierarchy, they have fewer checks on their decisions and face fewer organizational repairs.

The problem is particularly acute in acquisitions, where one firm pays to take control of another. Between 1976 and 1990 premiums to acquire firms averaged 41 percent, with many over 100 percent. Implicitly, the acquirers were claiming that they could manage the acquired firm at least 41 percent better than its current management. External observers rarely shared this level of confidence. When most acquisitions were announced, the combined stock price of the two firms involved generally *fell*, indicating the market predicted that the combined corporation would be less healthy than the two firms had been separately. In the long run, acquisitions tended to have lower profitability and returns and in many cases were later resold at a loss. Interestingly, the standard economic “solution”—providing monetary incentives—does not work. CEOs with the biggest financial stakes, as Ulrike Malmendier of Stanford University and Geoffrey Tate of the



How does a company pick out the best and worst employees—while ruffling the fewest feathers among the majority in the middle? One strategy, used by many firms, is illustrated by a high-tech company studied in 1992 by Todd Zenger of Washington University in St. Louis. Note that the majority receive a performance evaluation that identifies them as solidly “above average.” Here, as in Garrison Keillor’s Lake Wobegon, everyone can be above average, and people have evaluations that prove it.

University of Pennsylvania found in 2003, display the largest effects of flawed self-assessment. Providing incentives to someone who is clueless only ensures that he or she is clueless and committed to an unwise course.

What then? Like their employees, CEOs benefit from an outside perspective, such as from a board of directors. It is also important that outsiders maintain their outsider’s status. Even advisers and consultants may be seduced into taking the insider’s view. —D.D., C.H. and J.M.S.

Daniel Kahneman of Princeton University described a group of academics working on revising the curriculum of a local school system. When members were asked to predict how long it would take the group to finish the job, the single most pessimistic prediction was about two and a half years. On questioning, one member of the group did concede that, in his extensive experience, it usually took such groups seven years at best to complete their task, if they did it at all. The group ultimately wrapped up its work eight years later.

In sum, a wealth of evidence suggests that people may err substantially when they evaluate their abilities, attributes and future behavior. That said, we feel that the psychological literature has painted only a few brushstrokes of its portrait of the person as self-evaluator—and much more work must be done to fully render it. Perhaps more important, we need to develop a second image—one that depicts what an individual looks

like when he or she has achieved an accurate impression of his or her talents, capacities and character. How one retouches the first portrait to create the second is an issue that requires much more theoretical and empirical work. **M**

(Further Reading)

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- ◆ **Pluralistic Ignorance and College Student Perceptions of Gender-Specific Alcohol Norms.** J. Suls and P. Green in *Health Psychology*, Vol. 22, pages 479–486; 2003.
- ◆ **Flawed Self-Assessment: Implications for Health, Education, and the Workplace.** D. Dunning, C. Heath and J. M. Suls in *Psychological Science in the Public Interest*, Vol. 5, pages 69–106; 2004.
- ◆ **Symptom Perception and Health Care-Seeking Behavior.** R. Martin and H. Leventhal in *Handbook of Clinical Health Psychology*, Vol. 2, pages 299–328; 2004.
- ◆ **Self-Insight: Roadblocks and Detours on the Path to Knowing Thyself.** David Dunning. Psychology Press, New York, 2005.



Slipping on a pair of dark glasses, Agent Kay raises a mysterious handheld device before a crowd of shocked New Yorkers. Suddenly, the unit emits a brilliant flash of light that vaporizes all memory of a violent attack by space aliens from the minds of panicked earthlings who had just witnessed the horror. That “little flashy thing,” as Will Smith’s character calls it in this scene from the movie *Men in Black*, is not entirely science fiction; neuroscientists know how to erase memories of the recent past, while leaving well-established memories intact. And new research suggests that even long-term memories could be deleted.

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ERASING MEMORIES

Long-term memories, particularly bad ones, could be dissolved if certain drugs are administered at just the right moment during recall

By R. Douglas Fields

Erasing bad memories could be extremely therapeutic. Many people are haunted by painful experiences that cause lasting psychological problems. Forty-nine percent of rape victims suffer post-traumatic stress disorder (PTSD), as do 17 percent of people who survive serious vehicular accidents and 14 percent of those who unexpectedly lose a family member, according to the Posttraumatic Stress Disorder Alliance. Uncontrollable feelings of fear and horror can overwhelm sufferers. Devastating social and psychiatric complications can result, including depression, alcohol and drug abuse, and suicide. Persistent fatigue, digestive disor-

ders and unexplained chronic pain are also common. Sleep may offer no solace, as the distressing events return in vivid, recurring nightmares.

There is heightened interest in how to treat PTSD in the aftermath of the World Trade Center attacks, the Gulf War, Hurricane Katrina and other traumatic events. Psychiatrists expect the extended Iraq War to produce thousands more soldiers with recollections of terrible events, too. Psychotherapy and sedatives can help relieve symptoms, but the treatments have never been widely effective. The best antidote would be to uproot the cause—erase the horrible imag-

A single bad experience can burn fear into a person's brain.



ery. In principle, this is not a fantastic notion. We forget things all the time, and memory loss often follows accidents that involve head injury. Scientists are focusing on this line of therapy as they have come to understand exactly how the brain records as well as forgets events. And some questions are already being raised about whether erasing bad memories can be achieved without also disrupting good or necessary ones.

What to Keep

The shortcut to school crosses the old Dugan place, overgrown with weeds and littered with

system that accurately retains every event and sensory experience. (Anyone struggling to manage his e-mail knows the solution is not a bigger inbox—it is to delete files that will not be needed.) The trick for the brain is to somehow assess our minute-to-minute experiences and pick out instantly which ones should be retained for reference and which should be discarded.

The survival and reproductive value of certain events are immediately apparent, and memories of them are socked away permanently; after the Dugan episode you will never fail to recognize the snarl of an onrushing dog. Any experience that sparks fear or passion, any situation that is truly novel, anything you put in your mouth that tastes foul or delicious—each has a high probability of being retained as an event important for the future.

Knowing how a memory is encoded offers clues to how we could possibly erase it. Memories are not held inside neurons—the brain's cells. Both short- and long-term recollections are set in the connections between neurons called synapses—tiny gaps where the signal-emitting finger of one neuron (an axon) sends a message across to a signal-receiving finger of another neuron (a dendrite). A memory is created when a network of synapses is strengthened—temporarily for a short-term memory and permanently for a long-term one. Over time the network of connections can be strengthened further, weakened or broken.

The challenge of manipulating a memory can

(Preventing the synthesis of new proteins right after trauma could hinder long-term memory of the event.)

junk cars. Just as you set foot on the property, Old Man Dugan throws open his screen door and two pit bulls charge, snarling with teeth bared. You run for your life, narrowly escaping. The next morning and thereafter you take the long route instead. Returning years later to that place, your heart still races, even though Dugan is long gone. And in the years since the incident, you have developed a lifelong phobia for dogs.

Sometimes we don't need to be told twice. It takes repetition to learn that six times seven is 42, but a single experience can burn a fear of dogs and Dugan's place into a person's brain. Why? Because from a biological or evolutionary perspective, memory is about the future. There is no survival value in having a cerebral recording

become bewildering, however. The dendrite of one neuron can be surrounded by 10 to 100,000 axons, and the human brain contains more than 10 billion neurons.

One way neuroscientists attempt to understand memory networks is to retrieve thin slices of rat brain and artificially keep them alive in a lab dish. They then send electrical pulses into the neurons, which causes certain signals to fire across various synapses. Electrodes pick up the pattern of firings and display them on a computer screen.

The "firing" is actually a response to a neurotransmitter, a chemical messenger molecule released by an axon that crosses the synapse and binds to a dendrite's protein channels on the other

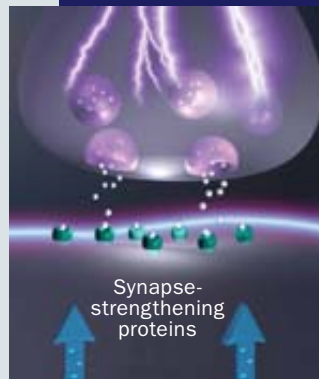
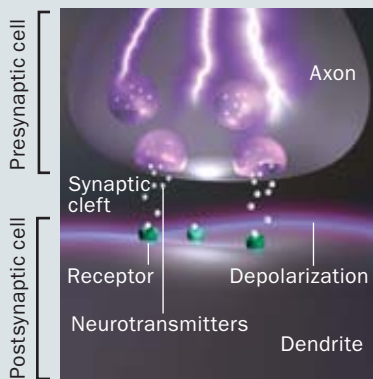
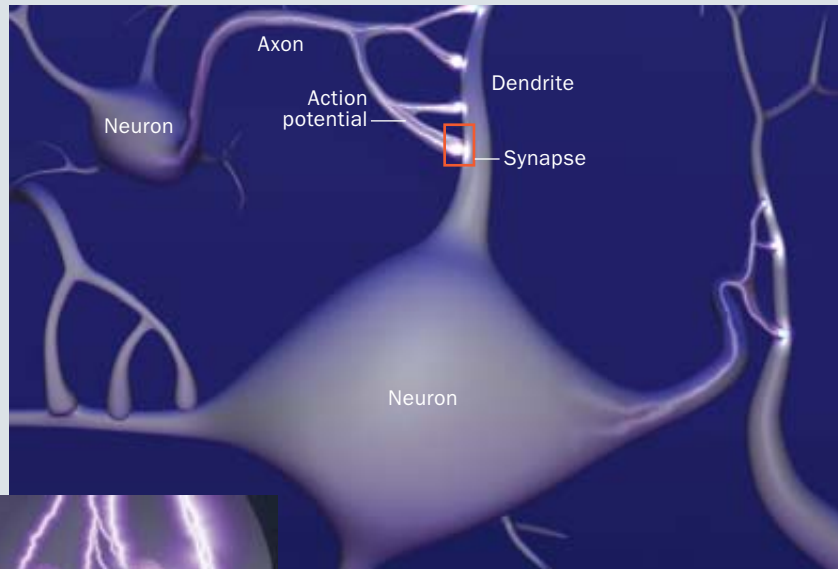
RICHARD HUTCHINGS Photo Researchers, Inc.

Making Memories

Memories are created when nerve cells in a circuit increase the strength of their connections, known as synapses. For short-term memories, the effect lasts only minutes to hours. For long-term memories, the synapses become permanently strengthened.

CROSSING THE GAP At the axon terminal (*below*), an electrical pulse causes synaptic vessels in the axon to release chemicals called neurotransmitters into a synaptic cleft between the axon and dendrite. The neurotransmitters bind to receptors on the dendrite, triggering a local depolarization of the cell's membrane that is described as a "firing" of the synapse.

SIGNAL PATH Messages begin to travel between neurons when an electrical pulse known as an action potential travels down an axon of one neuron and crosses a tiny gap, or synapse, to the dendrite of another neuron.



STRENGTHENING After a synapse fires briefly at high frequency, it becomes more sensitive (*left*), experiencing a greater voltage swing in response to subsequent signals. This temporary strengthening of the synapse is the basis of short-term memory. Permanent strengthening to form long-term memories requires the postsynaptic cell to manufacture proteins. The proteins might add more receptors and otherwise remodel the postsynaptic part of the region as well as influence the presynaptic cell's response.

side [see box above]. The channels allow a small flow of ions (charged molecules) to drain some of the voltage from the recipient neuron. When the voltage drops enough—because many synapses around it are firing together—the neuron sends an impulse down its own axon to relay the signal on to the next neuron in the network.

In 1973 Tim Bliss and Terje Lømo of the University of Oslo discovered that if they delivered a brief burst of pulses at the right frequency, around 100 hertz, the magnitude of the synaptic signal grew stronger and remained that way when it was tested minutes later. They named this phenomenon long-term potentiation, or LTP. A greater synaptic signal meant a stronger functional connection had formed between the two neurons—a piece of a memory.

Interestingly, the synapse remains "stronger" for several hours after a short series of shocks, but then the voltage slowly subsides to its original

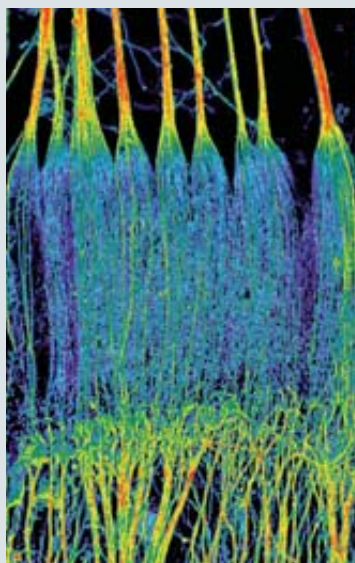
level. If three consecutive shocks are delivered at about 10-minute intervals, however, the synapse becomes permanently strengthened. As we all know from trying to remember people's names when we first meet them, repetition is necessary to move the data from short-term into long-term storage. Repeating the person's name three times right after you are introduced will not help as much as repeating the name to yourself every 10 minutes. In evolutionary terms, a stimulus encountered repeatedly is more likely to be important.

Making Memories Stick

There is a complication, however. The molecules that establish current flow around synapses are proteins, and all proteins in the body degrade and are replaced constantly over a period of hours or days. To strengthen a neural connection for a lifetime, some other process must take place to bolster the physical structure of a synapse or

Axons Unraveled

To form long-term memories, genes must turn on to make proteins that rewire the axon connections (*top, yellow*) between neurons. When the author shut down these genes in mouse neurons kept in a lab dish by applying an electric current, the axons began to unravel (*blue*). Drugs could potentially block genes right after the brain learns something new, preventing the experience from being fixed in long-term memory.



form additional synapses between the neurons involved.

The transition from temporary to permanent memory is called consolidation. Many experiments have determined that consolidation requires many hours, and it can be enhanced or blocked in various ways. As a young rock climber I used to marvel at how veteran climbers in Yosemite Valley in California could recount in vivid detail every inch of a climb that might have been several thousand feet, relating exactly where to find the hidden holds in sequence and just how to contort the body to make the next move. Later I learned that I could do the same thing. If the next 10 seconds of your life could be your last, you will remember them, even if the interval is followed by another 10 dramatic seconds, and so on, for the hours or days it might take to reach the summit. The heightened state of attention, stress and novelty stimulates the consolidation phase of memory.

Neuroscientists have discovered how this consolidation happens. An epinephrine (a.k.a. adrenaline) rush releases a flood of stress hormones and neurotransmitters that activate the amygdala, the brain region that processes fear and emotion. The amygdala connects to many other regions where different kinds of memories are stored, and it

boosts incoming data that have emotional impact. Consolidation, therefore, possibly can be aided by increasing levels of these neurotransmitters or hormones. This idea is the basis for memory-enhancing drugs, such as the illicit use of the attention-deficit medication Ritalin, or the mild and temporarily cognitive-enhancing effects of caffeine or nicotine. Clinical trials are now under way to improve memory consolidation in Alzheimer's patients using nicotine patches and more powerful medications. What if drugs were given to *inhibit* these neural circuits instead? The persistence of memories could be weakened.

Recent experiments on rats by Volker Korz and Julietta U. Frey of the Leibniz Institute for Neurobiology in Magdeburg, Germany, show exactly that effect. By implanting electrodes into the hippocampus, a critical memory center of the rat brain, they found that synapses there could be strengthened more permanently by subjecting rats to a stressful or cognitively challenging experience (finding their way through a maze). This challenge triggered stress hormones, and long-term potentiation induced by electrical stimulation did not fade as quickly as it would have otherwise. The researchers were later able to block this consolidation by using drugs that interfered with the neurotransmitters and hormones. The Frey group and others have also shown that a permanent increase in synapse strength can be undermined by adding drugs that block the synthesis of synapse proteins—in effect dissolving the memory.

Faster Forgetting

One approach to treating PTSD, then, would be to administer such blocking drugs immediately after a traumatic event. Such treatment would prevent the short-term memories from consolidating. There are drugs currently approved for use in humans that act on the receptors of these proteins, such as propranolol, used for certain cardiac patients. [For more on propranolol's memory-blocking effects, see "Can We Cure Fear?" by Marc K. Siegel, page 44.]

This approach would offer no help to the many PTSD victims whose horrible memories have already consolidated into permanent memory, however. But other methods hold promise. One possibility would be to speed up a psycho-

"REGULATION OF THE NEURAL CELL ADHESION MOLECULE L1 BY SPECIFIC PATTERNS OF NEURAL IMPULSES," BY K. ITOH, B. STEVENS, M. SCHACHNER AND R. D. FIELDS, IN *SCIENCE*, VOL. 270, 1995

Microinjecting inhibitors into a rat's amygdala right after recalling a bad memory can weaken it.

logical approach known as extinction. Therapists ask a patient to recall a stressful event repeatedly under safe and calm conditions. The repetition seems to inform the brain that this memory is no longer linked to a dangerous situation and therefore can be allowed to fade.

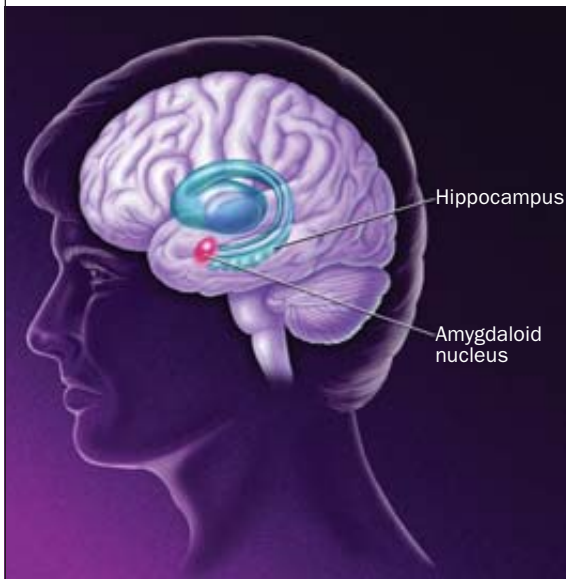
Lab mice that at one time were shocked in their cages while hearing a certain tone and later froze in fear when the tone sounded again eventually forgot the bad experience after the tone was subsequently heard at many intervals with no consequences. Yet in 2002 experiments by Beat Lutz, now at the Johannes Gutenberg University in Mainz, Germany, showed that mice genetically engineered to lack receptors in the brain for cannabinoids—molecules that resemble the active ingredient in marijuana—are not able to forget as rapidly. The theory is that the brain’s own “marijuana” calms the neural circuits involved in fear, allowing mice to relax more quickly when they learn that no electric shock follows the tone. If there were ways to boost the cannabinoids only in the amygdala, the brain’s fear center, this increase might help people with PTSD put their bad memories behind them more quickly. I should note that this targeted approach is not possible simply by smoking marijuana.

Understanding sleep may provide another avenue for erasing bad memories. A growing body of evidence suggests that memory consolidation continues “off-line” while we sleep, in part because sleep involves periodic surges of some of the same hormones and neurotransmitters that are aroused in stressful and novel situations. In 2001 Kenway Louie, now at New York University, and Matthew A. Wilson of the Massachusetts Institute of Technology found in rats’ hippocampi—vital for learning facts—that the same firing patterns recorded while the rodents were learning recurred during REM sleep.

In 2004 positron-emission tomography studies performed in humans by Philippe Peigneux of the University of Liège in Belgium showed that hippocampal areas activated while subjects learned their way around a virtual town were reactivated during subsequent non-REM sleep. Moreover, greater brain activity during sleep correlated with improved scores on tests of the subjects’ route-finding ability the next day. This work illustrates that memory consolidation requires sorting through fresh memories, integrating them with other memories, and shuttling them to different brain regions for permanent storage. Short-term memories deemed dispensable are discarded.

Genes Convert Short-Term to Long-Term

How might all these observations help us devise a strategy for erasing memories? There may be a common thread: genes. In 2004 Chiara Cirelli and her colleagues at the University of Wisconsin–Madison found increased activity in about 100 genes during sleep. Some of the genes are the same ones that are turned on when short-term memories are converted into long-term ones. The study by Lutz on rats and cannabinoids also confirms that different individuals have different levels of genetic predisposition to



The amygdala is key to recording emotionally charged memories, and the hippocampus is central to converting short-term memories to permanent ones.

fear and PTSD. (One implication may be that some of the alcohol and drug abuse of such people is perhaps an attempt at self-medication, albeit with inappropriate chemicals.)

Scientists have known since the 1960s that turning on genes was somehow involved in making memories permanent, because genes tell cells to produce proteins, and new proteins must be synthesized in neural networks within minutes of an experience for it to be coded as a memory. Using a mild electric shock as punishment, Bernard Agranoff of the University of Michigan at Ann Arbor in the mid-1960s trained goldfish to swim to one side of a tank when a light switched on. If Agranoff first injected a drug into a fish that blocked protein synthesis, the fish learned the

(The Author)

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task just as fast, but when tested three days later, it behaved as if it had never encountered the situation before. The fish could once again relearn the task just as rapidly as other fish, but the short-term memory was never converted into a long-term one.

Many other scientists have achieved similar results using a variety of animals and learning situations. But only recently have we pinned down just how genes direct memory formation. For a protein to be produced, a stretch of DNA inside a neuron cell's nucleus must be transcribed into a portable form called messenger RNA (mRNA). It travels out into the cell body, where its encoded information is translated into a protein. Experiments show that blocking the transcription of DNA into mRNA or blocking its translation to a protein allows short-term memory to stick but impedes long-term retention.

But why do genes turn on to transcribe DNA to begin with? Neuroscientists have found that when two neurons fire together strongly and repeatedly, calcium enters their nuclei and tells the genes to transcribe mRNA. New proteins are made from the mRNA that cement the short-term synapse connections into long-term memory networks.

forced to recall the experience. Shock treatment could make you forget your fear of dogs if you received it right after you revisited the old Dugan place. In the rat, recalling the memory had somehow made it vulnerable to disruption. This phenomenon has been termed reconsolidation.

Research over subsequent years expanded this result to other types of memories held in various parts of the brain in different animals and in response to a wide range of drugs. These include gene and protein-synthesis inhibitors as well as neurotransmitters and chemicals that affect them, called neuromodulators. Recent research by Joseph E. LeDoux and his colleagues at New York University has shown that microinjecting protein-synthesis inhibitors into a rat's amygdala can block memory reconsolidation if applied shortly after the memory is recalled.

A few neuroscientists are beginning to extrapolate this animal work to humans, who perhaps someday could take medication during an attack of PTSD to disrupt reconsolidation and thus undermine the bad memory. In 1994 James L. McGaugh, Larry Cahill and their co-workers at the University of California, Irvine, showed that propranolol, which blocks beta-adrenergic receptors, will make people forget an emotionally stressful

(Memory-suppressing drugs could be used by criminals on victims to eliminate incriminating testimony.)

No Fear

If we could find a way to block the synthesis of new proteins from genes immediately after a traumatic event, memory would not be consolidated and the horrible visions should fade away. Shock treatment, more formally known as electroconvulsive shock, seems to have such an effect in lab animals. But as with protein-synthesis inhibitors, the shock must be delivered at just the right time. And like the "neuralyzer" in *Men in Black*, the shock does not remove well-established memories (those about 24 hours old), because they are already consolidated.

Nevertheless, perhaps a similar mechanism could erase an experience already ingrained in long-term memory. Clues can be traced back to a 1968 study published in *Science* by James R. Misanin and others at Rutgers University. They found that a consolidated memory could be erased if a lab rat was shocked right after being

story more quickly, even though their memory of a pleasant story is not affected. Small-scale experiments with this drug in 2002 by Roger K. Pitman of Harvard Medical School were performed on people immediately after a traumatic experience in the hope that reducing the stress response would attenuate consolidation. After three months, the patients who were treated with propranolol were less likely to experience post-traumatic stress disorder than those who were not. The next step will be to see if the same drug could help people who already have PTSD, by asking them to take it when they experience an attack.

Erasing memory during the consolidation phase is science fact, not fiction, as anyone who has suffered amnesia can attest. I was left with a 90-minute gap in my memory after a fall from my bicycle. Although I never lost consciousness, my abnormal brain activity after hitting the pavement interrupted the normal consolidation of all



Medication could speed up extinction therapy, in which patients repeatedly recall a painful experience in a safe setting to convince the brain to allow the memory to fade.

short-term memories into permanent ones. Erasing all memory from a certain time interval could be troublesome, but it is likely that emotional memories could be selectively dissolved because they are coded into memory by a special mechanism. And their terrible, vivid recurrence in PTSD makes them uniquely vulnerable to treatment.

Of course, there could be a dark side to memory eradication. Some people fear that successful techniques could lead to a new kind of mind control. Brainwashing, a literal translation from the Chinese *xi nao*, changes a person's convictions through intensive indoctrination and propaganda, often using isolation, humiliation or torture. But never before has there been a way to truly wash away memory. If scientists succeed in developing a way to cut victims free from haunting memories, they will have forged a double-edged sword. There are memories we would rather not have and memories others might prefer us to lose. Memory-suppressing drugs could conceivably be used in espionage and warfare to free covert agents and their governments from incrimination or by criminals on their victims to eliminate witnesses. Considering the crude brainwashing methods practiced today by cults, political tyrants, criminals and armies, tomorrow's treatment to relieve suffering would, unfortunately, also appeal to the evil aspects of human nature.

These possibilities may or may not come readily. Memory reconsolidation is a well-established phenomenon, but some scientists argue that older

memories develop deeper and broader roots as they become connected with other experiences and memories, and they may be hard to purge. Others think that memories must be renewed when they are recalled to integrate them into the brain's subsequent experience and are therefore transient and open to disruption.

Either way, complications could be a problem. For example, because memories are the physical remodeling of synapses, it is possible that each new memory might impact synapses encoding an old memory. Erasing a painful image from the past could alter other images the brain needs for the present. In *Men in Black*, Will Smith's character warns his partner not to flash the neurolyzer again, saying, "You ain't gonna be happy till you fricassee somebody's brain." It is doubtful that any memory-erasing technique would cause brain damage, but in the bargain for a second chance to choose our memories, are we lifting the lid on Pandora's box? **M**

(Further Reading)

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Brian Wilson: A Cork on the Ocean

The rise and fall of the Beach Boys leader shows how crucial the brain's executive function is to creativity

By Brian Levine

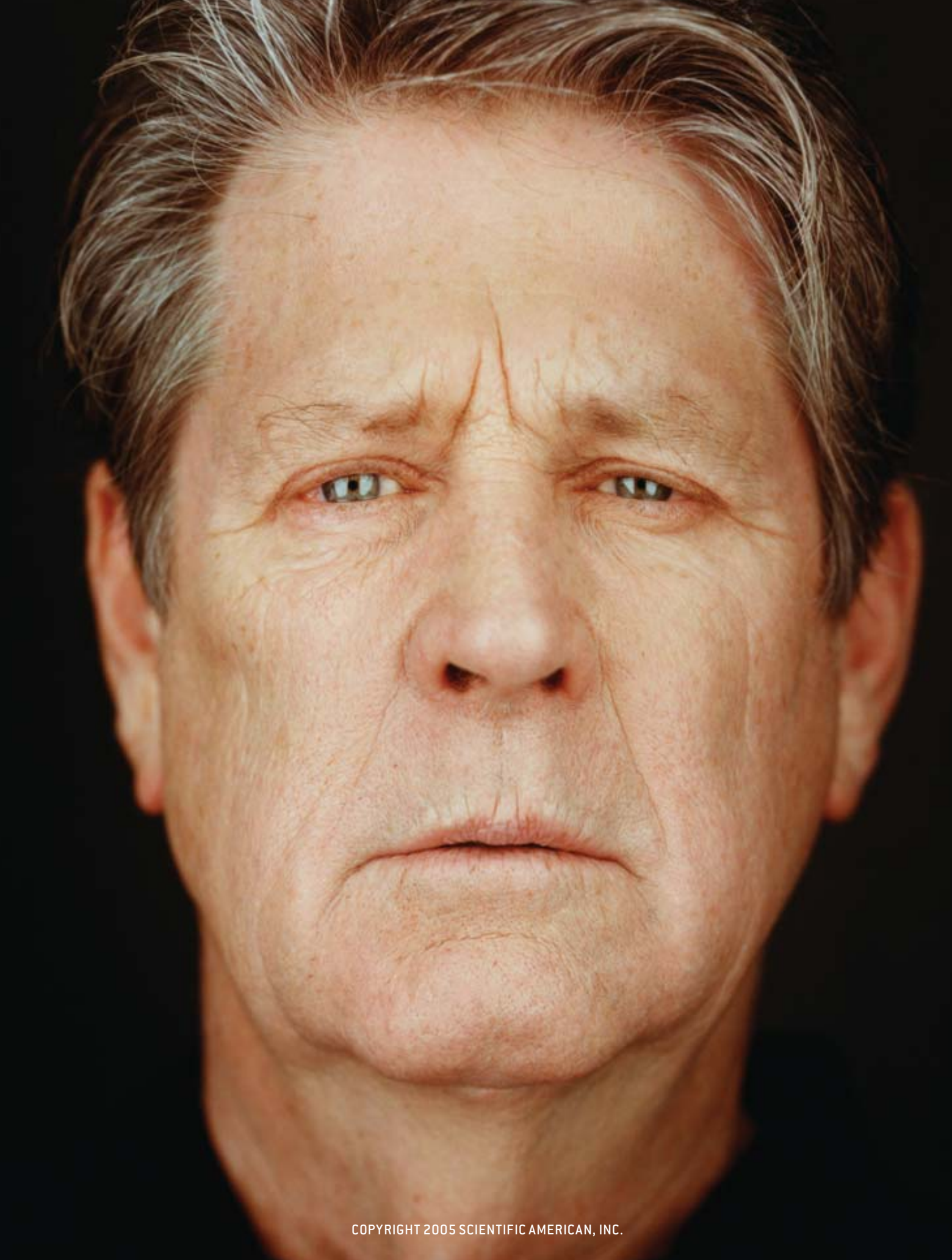
What differentiates mere talent from creative genius? No one knows for sure. We do know, however, that many artistic advances and scientific discoveries come from men and women in their 20s—just old enough to have sufficient technical skills yet young enough to be unencumbered by the habits of older generations.

Psychological studies also indicate that highly creative people share an elevated risk of serious mental illness. For certain

individuals, such ailments may actually contribute to their soaring achievements. Yet often the same condition eventually ruins their inventiveness and their lives. Perhaps no story better exemplifies how mental illness can free up creativity, then crush it, than that of Brian Wilson.

By age 22 Wilson had already invented a new form of American folk music, achieving tremendous success with his group, the Beach Boys. From 1962 to 1965 the Beach Boys had 16 top-40 hits, including “Surfin’

MARTIN SCHOELLER Corbis Out/line



Brian Wilson (at left) was the primary writer, arranger and producer for the Beach Boys, who by 1965 had more than a dozen top hits, such as “Surfin’ USA” and “I Get Around.”



USA,” “Little Deuce Coupe” and “I Get Around.” Wilson, the group’s primary writer, arranger and producer, then expanded his musical landscape with the Beach Boys’ 1966 record *Pet Sounds*. The album altered the course of modern pop with its novel studio techniques, complex harmonic and rhythmic structures drawn from jazz and classical music, unusual instrumentation, and substantive themes of introspection and vulnerability. The legendary conductor and composer Leonard Bernstein called Wilson one of the greatest composers of the 20th century, and Paul McCartney of the Beatles cited *Pet Sounds* as the major influence for the group’s own inventive landmark album in 1967, *Sgt. Pepper’s Lonely Hearts Club Band*.

Unfortunately, the importance of Wilson’s work was soon overshadowed in the popular consciousness by his steady and very public mental decline. In his early 20s, the typical age of onset for many psychotic disorders, social discomfort, depression and paranoia gave way to frank hallucinations and delusions. Over the following decade his condition progressed, and for a period of years he was unable to function con-

sistently as a member of society, much less at his previous level as a hit-record producer.

Progressive mental illness such as that experienced by Wilson causes a breakdown in “executive function”—the ability of the brain’s frontal lobes to plan, coordinate and execute, much the way a CEO would direct the operations of a business. Cognitive neuroscientists are still debating the definition of executive function and its influence on behavior. But Wilson’s case provides powerful evidence of its sway. Today, 30 years after his decline, Wilson has reemerged as a healthier individual and has returned to making music. His incredible story shows how executive function can set creativity free, how its demise can subsequently cripple that creativity and the ability to negotiate daily life, and how proper treatment and support by psychiatrists and loved ones can create ways to compensate—in Wilson’s case, allowing him to make a comeback.

“Til I Die”

Neuroscientists maintain that the frontal lobes mediate a collection of high-level cognitive processes that enable us to control and direct

Certain mental illnesses can actually contribute to artistic achievements but eventually ruin lives.

lower-level processes. These executive functions allow us to transform a jumbled heap of puzzle pieces into a coherent picture. Think about preparing to go on a major trip. Your brain's CEO, working from the frontal lobes, sequences and prioritizes the many steps that must be performed, generating a plan to accomplish your goal and coming up with new tactics when circumstances change [see box on page 41].

Because the frontal lobes interact with multiple brain systems, executive functions are highly sensitive to brain disease, psychiatric disorders and substance abuse. Despite their central role and vulnerabilities, however, executive functions are not as well understood or appreciated as other mental capacities, such as memory and perception, which are more easily assessed in the lab. And because demands for executive functions are greatest in unstructured, novel situations, patients with executive difficulties often appear normal when taking routine psychological and neurological tests. Executive dysfunction is therefore often not diagnosed,

even in people who are seriously disabled by it.

The creative innovations heard on *Pet Sounds* coincided with the onset of Wilson's psychosis, which is characterized by a loosening of linkages between ideas. (This article is based on publicly available information, such as the authoritative books *The Beach Boys*, by David Leaf, and *The Nearest Faraway Place: Brian Wilson, the Beach Boys, and the Southern California Experience*, by Timothy White; documentaries such as *A&E Biography*; media interviews with Wilson himself—notably *Larry King Live* in 2004—as well as other sources. I have not talked to Wilson, nor have I seen his medical records, but the many sources converge on a description that experts would recognize as psychosis.)

Mental illness does not make a person creative. But certain individuals who are endowed with artistic vision and particular technical skills can, at times, transform the loosening of linkages into inspired artistic associations. These novel associations can be difficult for the individual to harness, however, because a person

A young Wilson, shown here in 1966, held in his mind intricate arrangements of many instruments and vocal harmonies, instructed older musicians to perform each part in the studio, then wove them together electronically, a masterful feat of executive function.



Executive functions are highly sensitive to brain disease, psychiatric disorders and substance abuse.



Once psychosis took root, Wilson had only intervals of creativity; his weight ballooned, he seldom performed, and he confined himself to his bed for long periods.

with psychosis is betrayed by his own disordered perceptions. It is a frighteningly lonely disease, which Wilson perhaps knowingly portrayed in 1971 when he wrote “Til I Die.” The song’s lush music, reminiscent of the sea, stands in stark juxtaposition to the lyrics: “I’m a cork on the ocean / Floating over the raging sea.... I’m a leaf on a windy day / Pretty soon I’ll be blown away....”

Wilson had reached a breaking point in late

1964 on a plane flight to Houston, when he suffered a nervous breakdown. He subsequently stopped touring with the Beach Boys so that he could focus his attention on writing and studio work for the band, avoiding the stress of the road. He used the Wrecking Crew for the instrumental recording sessions, the same studio musicians employed by his idol, Phil Spector, who defined the role of the modern record producer with hits by the Crystals and the Ronettes, such as “Da Doo Ron Ron.” Wilson’s new work, appearing in 1965 on the next two albums, *The Beach Boys Today!* and *Summer Days (and Summer Nights!!)*, introduced elements that later came together in fully realized form on *Pet Sounds*.

To create *Pet Sounds*, Wilson enlisted a new collaborator, Tony Asher, to assist with lyrics intended to depart from the previous themes of surfing, girls and cars. Wilson constructed songs at the piano, beginning with “feels” or fragments of music representing a certain mood. By the time he entered the recording studio, he had a full arrangement in his mind that he then deconstructed by teaching musicians their parts one instrument at a time—from strings, horns and accordions to a water jug, bicycle bells and the theremin, the electronic gizmo responsible for spooky sounds in old horror movies and later made famous in the Beach Boys’ song “Good Vibrations.” Indeed, Wilson often demonstrated the parts himself, because he could play nearly all the instruments. Outtake recordings of Wilson working in the studio (which were included in the 1996 *Pet Sounds Sessions* box set) give an impression of a 23-year-old visionary leader directing the older and more experienced studio musicians to realize his artistic vision.

The last elements to be laid down on the album were the Beach Boys’ vocals. No one but Wilson knew how the pieces would fit together until he assembled them at the final stage of production, when something spiritual emerged. As the late Timothy White, editor in chief of *Billboard* magazine throughout the 1990s, wrote in the liner notes to *Pet Sounds Sessions*, “What shines brightest behind, within and above the peal of Brian’s exquisite material is the presence of the thing not named: an unswayable belief in the enduring power of one’s better self.”

MICHAEL OCHS ARCHIVES.COM

(The Author)

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The Brain's "CEO"

The role of executive function in human behavior is to coordinate the many brain activities needed to set goals, make plans to attain those goals, organize steps to carry out those plans, and ensure that the desired outcomes are achieved. This capacity can be likened to that of a company's chief executive officer. Psychologists are not in full agreement, but most acknowledge that multiple executive functions are mediated by the frontal lobes. The ones described below are engaged often.

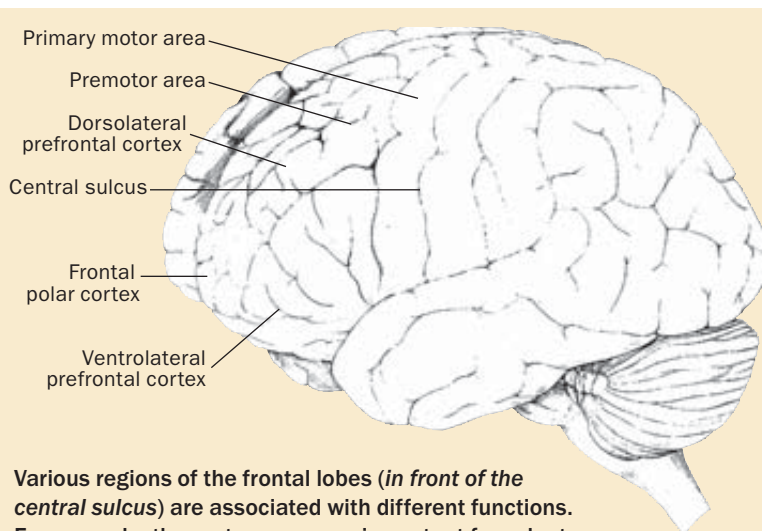
Abstract thinking. Discerning relations among stimuli—seeing the forest for the trees—depends on abstract thinking. Imagine being asked to group into two sets of objects a pair of scissors, a water glass, an ax and a wheelbarrow. You might decide that the scissors and the water glass go together because they are used indoors, whereas the ax and wheelbarrow are used outdoors.

Attention shifting. Can you find another grouping? Scissors and axes cut, glasses and wheelbarrows contain. Many people with executive deficits find it hard to shift attention and inflexibly hold on to their original perceptions and behaviors, even when the usefulness of these associations has long expired.

Information manipulation. Nearly all higher-order cognitive operations require the real-time manipulation of information held in short-term memory. To prepare for a dinner party, a host has to juggle multiple timetables of when different foods will be cooked as well as consider the likes and dislikes of guests.

Planning and foresight. Preparing for a vacation requires foresight and analysis of the conditions and needs at the destination, which may be very different from the conditions and needs at home. A patient with executive dysfunction is often unable to escape the present to form a mental model of a future that is different.

Monitoring and error correction. These processes are engaged when results do not correspond with intentions.



Various regions of the frontal lobes (*in front of the central sulcus*) are associated with different functions. For example, the motor areas are important for voluntary movement. The prefrontal cortex mediates executive functions.

This effect could be seen, for example, in a woman who drives to a special bakery to buy a pie for a dinner party she is throwing that evening and finds it is closed. She might go to another bakery on the other side of town without considering that the trip would not allow her to get back home until long after the guests had arrived.

Decision making. Consider a man who is having trouble making ends meet. He could cut expenses or increase income, either path requiring him to weigh options, arrive at a decision and see it through. Patients with executive difficulties cannot settle on a choice, particularly in situations where the correct response is not obvious or previously learned. They may blindly follow other people's suggestions, which is why they can be easily exploited.

Inhibition. Automatic responses can be unhelpful or even harmful. Imagine you have just won a major award; your reaction would be to tell everyone your news. But waiting until other finalists are properly informed of their loss requires inhibition.

Social functioning. Failure to appropriately process or output social cues can have devastating consequences. The main concern of one frontal lobe dementia patient, on seeing that his wife was cut and bleeding badly from an accident involving a power tool, was that the tool be cleaned as soon as possible.

—B.L.

Recording multiple instrumental and vocal tracks and fitting them into a coherent whole relies on manipulating many streams of information held in short-term memory, a key executive function. Whereas other producers at the time

recorded relatively simple songs in a single "take" performed by the entire group, Wilson held in his mind intricate symphonic arrangements and harmonies, recorded parts separately, then later put together the pieces of the puzzle. The song "Good

Vibrations,” dubbed a “pocket symphony” by Wilson and released as a single just after *Pet Sounds*, was recorded in 17 sessions at various studios. The hit, which in music polls ranks as one of the greatest pop songs ever, represented the ultimate marriage of creativity with executive functions, prompting a key transition in popular music in which the studio itself was added to the impresario’s quiver.

How was Wilson able to accomplish these monumental feats of vision and concentration while suffering from serious mental illness? Psychotic symptoms are not static; they wax and

ting his musicians with fire hats during the recording of “Mrs. O’Leary’s Cow” or infamously placing his piano in a sandbox. Yet because by this time he had been labeled as a “genius,” people around him often indulged his eccentricities rather than confronting them as symptoms of serious sickness. Evidence of faulty monitoring can also be heard in the original *Pet Sounds* recording, in which Wilson, usually the consummate perfectionist, allowed background chatter from the studio to creep into the final mix.

Once he had completed *Smile*’s elements, Wilson seemed unable to fit them together. Parks eventually left the project, according to several accounts. Capitol Records was pressuring Wilson to produce something. But emotionally fragile and without support from his bandmates, he scrapped the *Smile* project in mid-1967. That summer acid rocker Jimi Hendrix literally sounded the death knell for surf music at the Monterey Pop Festival.

Wilson’s mental health steadily deteriorated, with occasional bouts of suicidal depression and psychosis. His drug habit, which could have been an attempt to self-treat his symptoms (common among patients with psychosis), expanded into heroin and especially cocaine use. He demonstrated intervals of creativity, but he never matched the breadth and complexity of his earlier work. He had two young children but was unable to assume a parental role and separated from his wife in 1978. By the early 1980s Wilson’s weight had ballooned to more than 300 pounds, and he confined himself to his bed for two and a half years. Although there were periods of hospitalization and detox, treatment was not sustained. Wilson’s public appearances were inconsistent at best.

Because of his tremendous notoriety, Wilson’s mental troubles soon became part of the public consciousness. The media mocked him as some kind of nut. Viewed from the patient’s perspective, however, staying in bed makes perfect sense when one is immersed in a warped reality.

As is often the case with patients who have executive dysfunction, Wilson’s compromised state left him vulnerable to exploitation. His own psychologist, Eugene Landy, directed his life and career in the mid-1970s and then again from 1983 to 1991, according to several accounts and to Wilson’s second wife, Melinda, during the Larry King interview. Although Landy was successful in isolating Wilson from illicit drugs and in helping him to lose weight, he also fostered a dependent relationship: he administered psycho-



Improved therapy for schizoaffective disorder, along with support from his friends and second wife, Melinda, enabled Wilson to return to active touring after 30 years.

wane. Wilson’s productivity was most likely greatest when his symptoms were in remission—when novel creative associations could be screened, manipulated and coherently integrated by his musical and executive powers.

Two Years in Bed

These powers were soon eclipsed by Wilson’s progressive mental illness. The balance between inspiration and the cognitive capacity to realize that inspiration had shifted by 1967, as he and lyricist Van Dyke Parks were putting together *Smile*, an integrated set of album cuts centered on American culture and history.

A good indication of how Wilson’s capabilities were slipping involves “output monitoring.” This executive function gives someone the ability to compare his actions to his intentions—to screen for errors and bad ideas. Wilson used unusual but successful sound ideas on *Pet Sounds*, such as bicycle bells to invoke themes of lost childhood, but his quest during *Smile* became bizarre—outfit-

AP PHOTO

tropic drugs to Wilson, acted as his business adviser, and even attempted to collaborate with the artist on songwriting and singing. Wilson's family sued for conservatorship in 1990, and the issue was settled the following year. The court severed contact between Wilson and Landy, who had by then already surrendered his license to practice psychology in California to the state's Board of Medical Quality Assurance after conceding that he had unlawfully administered drugs to Wilson.

Creative Prosthesis

Throughout the 1990s Wilson received more conventional treatment, including medication and psychotherapy. He settled into a stable marriage. During the Larry King interview, Wilson and Melinda revealed that he had been diag-

but it weakened for some reason—and I lost the ability to concentrate enough to follow through.” Wilson is also now appearing live, sitting in front of a keyboard, although he does not play much. His singing, though still serviceable, is inconsistent. None of this really matters to his fans, however, who come for Wilson's legend and mystique.

Wilson reached a creative zenith in his early adulthood in spite of (and perhaps partly because of) his mental illness, which eventually robbed him of the cognitive abilities required to create art and nearly destroyed him. Wilson's comeback demonstrates that with proper treatment and support, individuals with mental illness can function at a high level in areas of their expertise, even if their symptoms persist.

During the painful interim, life took down

(Wilson's comeback shows that with proper treatment, a life lost to psychosis can rebound.)

nosed with schizoaffective disorder, a combination of psychosis and abnormal mood. With support from his wife and musical colleagues, Wilson was reemerging in public, recording albums and performing as a solo artist, accompanied by musicians from the Los Angeles band the Wondermints and former Beach Boys guitarist Jeff Foskett.

Improved treatment of schizoaffective disorder has helped Wilson and many others. After more than 30 years he returned his attention to *Smile*, widely considered one of the greatest unreleased albums in contemporary music. Wilson appeared comfortable in the recording studio—executive dysfunction does not directly compromise memory or acquired musical skills. But it does affect the capacity to flexibly deploy them, particularly in an unstructured situation where there are no clear right or wrong answers, as in the creation of an album.

Wilson released *Smile* in 2004, at age 62, to worldwide acclaim. Its success is attributable to the quality of the original material and to the guidance and support of others who helped Wilson assemble the pieces—people who provide a prosthesis for Wilson's frontal lobes. According to Timothy White's book, Wilson had recognized this need as early as 1976, when in a recording session he said, “Something happened to my concentration—I don't know exactly what,

other family members in the Beach Boys. Wilson's brother Dennis, the heart of the band, drowned in 1983, and brother Carl, the guitarist with the angelic voice, died of cancer in 1998. And whereas *Pet Sounds* was so perfectly poised in time, the political, cultural and musical milieu that spawned *Smile* almost immediately became a casualty of violence, war and lost innocence.

To paraphrase renowned psychologist and memory researcher Endel Tulving of the Rotman Research Institute in Toronto, time's arrow runs straight, but memory endows us with the capacity to bend that arrow into a loop, to revise the past in our minds to regain, even if in fantasy, that which was lost. If Wilson's public resurrection bolsters this hope, then *Smile* 2004, bending time's arrow back 37 years, codifies it. Perhaps, then, *Smile* fulfills a larger purpose beyond its lush and creative music: the need to believe that that which was lost can be regained. **M**

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We naturally view any risk we witness as a personal threat—even when it is on the opposite side of the globe and we see it only on TV. Is popping a pill the answer?

By Marc Siegel

Can We Cure FEAR

In early 2004 my daughter, Rebecca, was taking a bath. She was almost three years old. When the tub's Jacuzzi device turned on, she became petrified. I raced to her side, to find her standing straight up, bright red from crying.

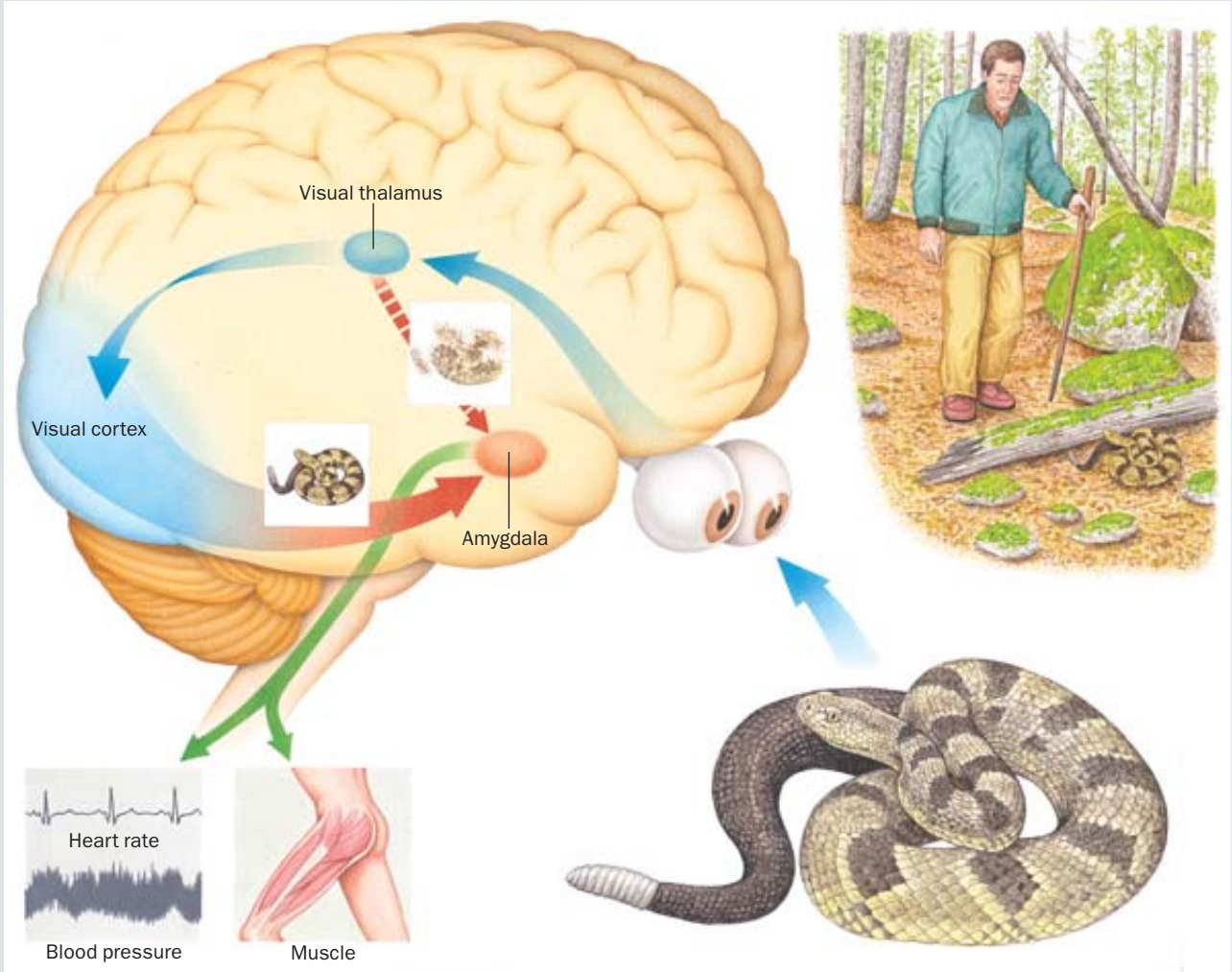
For months afterward, she abhorred baths. As a physician who has studied the neurobiology of fear, I knew that the prefrontal cortex of her young brain had just finished wiring its "safety center," where analytical reasoning can overcome primitive emotions. I tried to appeal to her newly working brain center to suppress the worry that this

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The Fear Response

Cortical and subcortical pathways in the brain may bring about a fearful response to a snake on a hiker's path. Visual stimuli are first processed by the thalamus, which passes rough, almost archetypal, information to the amygdala (red). This quick transmission allows the brain to respond to the possible danger (green). Meanwhile the visual cortex also receives sig-

nals from the thalamus and, with more sophistication and more time, determines that there is a snake on the path (blue). This information is relayed to the amygdala, causing heart rate and blood pressure to increase and muscles to contract. If, however, the cortex had determined that the object was not a snake, the message to the amygdala would quell the fear response.



tub would always bring the scary bubbles, but her body's innate response was too strong. By starting with showers and diverting the focus of her attention from the tub, I was gradually able to return her to baths. But to this day she is wary of bubbles.

Why is fear so intractable? And what can we do about it? Therapy has provided succor for many people; others have relied on the strength they get from their faith or other support networks. But in a world where we regularly witness hair-raising events—such as the aftermath of suicide bomber attacks in full color on our living-room televi-

sions, on Web sites and on newspapers' front pages—is such verbal support enough? Answering a perceived need, fear-blunting medications are coming onto the scene. Could we—should we—all simply pop pills to ease our anxieties?

Fear is more than a state of mind; it is chemical. The feeling of alarm arises from the circuitry of our brains, in the neurochemical exchanges between nerve cells. Fear is a physical reaction to a hazard. As long as the danger is direct and real, fear is normal and helps to protect us. Fear also has a genetic component. A rat will recoil from

the odor of a fox, even if that rodent has spent its whole life in a laboratory. Likewise, we humans are automatically apprehensive about situations that once threatened our ancestors.

When one feels threatened, the metabolism revs up in anticipation of an imminent need to defend oneself or flee. “Fight or flight,” or the acute stress response, was first described in the 1920s by Walter B. Cannon, a physiologist at Harvard University. Cannon observed that animals, including humans, react to dangers with a hormonal discharge of the nervous system. The body unleashes an outpouring of vessel-constricting, heart-thumping hormones, including epi-

we have only read or heard about, so we may worry about disasters we may never experience. If we are unable to respond for lack of an appropriate target, we become anxious.

Adding to the problem—according to studies of how humans evaluate risks by University of Hawaii at Manoa psychologists Robert J. Blanchard and D. Caroline Blanchard—is that people often fail to assess the level of threat accurately. We tend to overpersonalize risk and to experience an unrealistic sense of peril when we hear or read of a bad event occurring to someone else.

For example, my mother-in-law has a severe case of multiple sclerosis and has been confined

Once a person has learned to feel apprehensive about something, he or she may always dread it.

nephrine, norepinephrine and the steroid cortisol. The heart speeds up and pumps harder, the nerves fire more quickly, the skin cools and gets goose bumps, the eyes dilate to see better, and the areas of the brain involved in decision making receive a message that it is time to act.

At the center of these processes is the amygdala, an almond-shaped region of the brain. Neuroscientist Joseph E. LeDoux of New York University, a pioneer in the study of the fear cycle, describes the amygdala as “the hub in the brain’s wheel of fear.” The amygdala processes the primitive emotions of fear, hate, love and anger—all neighbors in the deep limbic brain we inherited from animals that evolved earlier. The amygdala works together with other brain centers that feed it or respond to it. This fear hub senses through the thalamus (the brain’s receiver), analyzes with the cortex (the seat of reasoning) and remembers via the hippocampus (the memory-input device).

It takes only 12 milliseconds, according to LeDoux, for the thalamus to process sensory input and to signal the amygdala. He calls this emotional brain the “low road.” The “high road,” or thinking brain, takes 30 to 40 milliseconds to process what is happening. “People have fear they don’t understand or can’t control because it is processed by the low road,” LeDoux says.

Fear Factor

Once a person has learned to feel apprehensive about something, he or she may always feel dread associated with that experience. And unlike mice, we humans can be alarmed by events

to a wheelchair for almost 20 years. Six years ago my brother-in-law developed a mild case of MS, and my wife, a neurologist, then confided in me her fear, practically a conviction, that she would be next. Every time she brings up her perception that MS is her destiny, I try to counter it with the bald statistic that only 4 percent of close relatives are at risk for the disease. “There is a 96 percent chance that you won’t get it,” I say. But for my wife, as for many others, the perception rests with the 4 percent. Empathy for her mother and a natural tendency to personalize her experience create the fear and the conviction, despite her neurologist’s knowledge of the disease.

Recurrent or unremitting fear has the same deleterious effects on the human body that running persistently at 80 to 100 miles per hour has on a car. Many illnesses are more likely to occur as a result, including heart disease, stroke and depression. Thus, we should focus our efforts on avoiding the ordinary killers such as heart attacks that develop as a result of our unremitting worries rather than extraordinary occurrences or exotic diseases. Consider: in 2001 terrorists killed 2,978 people in the U.S., including five from anthrax attacks. That same year, according to the Centers

(The Author)

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Fear Not

I learned how to defeat fear from one patient, whom I'll call Joel Enrand. Enrand had an overriding terror of losing everything—his health, his job, his family—leading to depression, weight gain, high cholesterol and elevated blood pressure. Most of all, because of his paralyzing middle-of-the-night bouts of sleepless panic, he was concerned about losing his mind. "You're not crazy," I reassured him. The tiny muscles around his eyes then relaxed. Enrand soon embarked on a program of his own design, willing himself to jog three miles a day before work, eat regularly and limit himself to two cigars per week as his "one vice." After six months he sat, at ease, in my office.

"My courage is back, Doc," he said. "Things were happening to me. I latched onto the worry. I could feel it, like it was real. It gripped me, and it grew."

"But you fought it?"

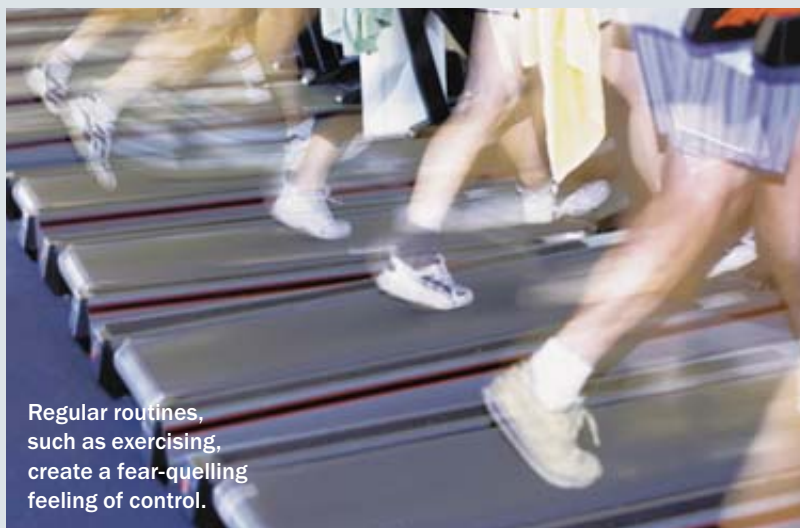
"Just by sticking to routines, rituals; they replaced the doubts little by little. When I saw I was getting my life back, I started to enjoy the routines." Enrand hesitated. "Most important," he said, "I'd always wanted to be a dad, and I loved my son more than anything, and I knew I was responsible for him. He needed me, and I grew stronger by refusing to let go of him."

Many of the ways we can keep an

even keel mentally also make good common sense:

- Avoid overhyped TV news programs or Web sites, which leave you susceptible to personalizing the dangers depicted.
- Like Enrand, identify what matters to you—and use that knowledge to bolster your courage.
- Practice the "five R's": regular sleep, regular meals, regular entertainment, regular exercise and regular work schedule. Establishing order and control over many aspects of your daily life eases stressful fears.

—M.S.



Regular routines, such as exercising, create a fear-quelling feeling of control.

for Disease Control and Prevention, heart disease killed 700,142; cancer, 553,768; accidents, 101,537; and suicide, 30,622. Murders (not including 9/11) accounted for only 17,330 deaths.

Liquid Courage

So what can be done about irrational fear? There is no one standard treatment in part because symptoms vary from one individual to the next. A person may feel destined to a given bad outcome and have a greater sense of foreboding because of a certain family tendency. Some people's bodies more easily release the fight-or-flight hormones than others. Time-consuming therapy and the resulting reeducation, to avoid triggering our fears, have been the chief solution to date. Now research also suggests therapy could be supplemented by a simple pill that blocks the reception or production of fear signals or even by a fear "vaccine." The fear research does not seek a traditional vaccine—in which the immune sys-

tem develops protective capabilities in response to the presence of an injected (inert) disease agent. Rather the immune system might be chemically primed with a shot so that it is as healthy as possible—making the body less susceptible to hyperreacting to threats.

One of the first clues that an avenue to treating fear could be to stop certain signals from being received or transmitted by neurons came from work by neuroscientist Larry Cahill of the University of California, Irvine. In 1994 Cahill tested on humans the effects of the drug propranolol, a beta blocker that stops the reception of stress hormones called catecholamines. He found that the drug prevented people from recalling a gory story better than a bland one. Ordinarily, the mild stressfulness of hearing an exciting story makes it more memorable than an uneventful tale. Propranolol is routinely prescribed for anxiety relief and to treat high blood pressure and related ailments, but Cahill's re-

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search suggests it has a greater potential for treating fear.

Along these lines, Roger K. Pitman, a professor of psychiatry at Harvard University, theorized that administering propranolol can both prevent the laying down of fear memories and blunt the fight-or-flight response. In 2002 Pitman and his group looked at the effects of giving propranolol to 41 people in the emergency room, starting within six hours of a traumatic event (mostly car accidents). The study participants received the drug for 10 days. Three months after the trauma, Pitman found a significantly lower

Blunting fearful memories with pills or vaccines is, however, not the same as retraining the brain so that it is better equipped to handle future situations. Regardless of the development of such medicines, therapy will continue to play an important role in treatment for fear. As the President's Council on Bioethics put it in the 2003 book *Beyond Therapy*, "Use of memory-blunters at the time of traumatic events could interfere with the normal psychic work.... There is a danger that our new pharmacological remedies will keep us 'bright' or impassive in the face of things that ought to trouble, sadden, outrage, or inspire

Could medical remedies keep us impassive in the face of things that ought to sadden, outrage or inspire us?

incidence of post-traumatic stress disorder in those who received the drug than in the control group, which had not received the drug.

Another way to hinder the fear response is by disrupting signal production. LeDoux and Karim Nader of McGill University reported in the August 17, 2000, issue of *Nature* that when rats received a shot of anisomycin, an antibiotic that inhibits protein synthesis, their fear memory was blocked. They could not recall a previous fright and could not trigger a new fight-or-flight response, because the amygdala could not make the signaling molecules.

Reducing neural overreaction is another approach. In a study by neurobiologist Jonathan Kipnis, now at the University of Nebraska Medical Center, and his colleagues published in the May 25, 2004, issue of *Proceedings of the National Academy of Sciences USA*, the authors found evidence that immunological "vaccines" could prevent excess fear. They injected normal mice with amphetaminelike drugs that caused psychotic symptoms. Some of the mice received the protective vaccine, a chemical cocktail known as glatiramer acetate, or copolymer-1 (Cop-1); a control group got no vaccine. Cop-1 stimulates production of immune system T cells, which protect nerve cells from "irritability," or hair-trigger firing. The mice that received Cop-1 were able to learn to swim through a maze in recognizable patterns, whereas the control mice could not do so. The Cop-1 mice exhibited normal calm behavior, showing that they avoided a state of panic. This kind of immune modulation has yet to be studied in humans, but such experiments are anticipated.

us—that our medicated souls will stay flat no matter what happens to us or around us."

For years, I have tried to help my patients handle their disease fears without knowing if I am succeeding or not. In studying the fear circuitry of the brain, I have come to appreciate that teaching might not automatically lead to learning. Fear is a deep-rooted emotion, difficult for the brain to control. Sometimes it cannot be avoided. My daughter's experience with the bubbles taught me that if fear is unlearned, it is because a new emotion replaces it. (She developed courage about returning to the bath.) This healing occurs at its own speed, and a parent, or a doctor, often has little control over it.

To conquer fear we must return it to its primitive place as an instinct reserved for protecting us from true physical dangers. We must stop overpersonalizing it. We must resist those in the media and elsewhere who highlight the wrong dangers and hype the need to respond—making the threat seem even more real. We must regain our footing by exerting order over controllable aspects of our lives [see box on opposite page]. We must replace our unreal fears with real courage. **M**

(Further Reading)

- ◆ **The Emotional Brain: The Mysterious Underpinnings of Emotional Life.** Reprint edition. Joseph LeDoux. Simon & Schuster, 1998.
- ◆ **The Culture of Fear: Why Americans Are Afraid of the Wrong Things.** Barry Glassner. Basic Books, 2000.
- ◆ **Emotions Revealed: Recognizing Faces and Feelings to Improve Communication and Emotional Life.** Paul Ekman. Owl Books, 2004.
- ◆ **Does Stress Damage the Brain? Understanding Trauma-Related Disorders from a Mind-Body Perspective.** New edition. J. Douglas Bremner. W. W. Norton and Company, 2005.

EXPLODING THE SELF- ESTEEM MYTH

BOOSTING PEOPLE'S SENSE OF SELF-WORTH HAS BECOME A NATIONAL PREOCCUPATION. YET SURPRISINGLY, RESEARCH SHOWS THAT SUCH EFFORTS DO LITTLE TO IMPROVE ACADEMIC PERFORMANCE OR PREVENT TROUBLESOME BEHAVIOR BY ROY F. BAUMEISTER, JENNIFER D. CAMPBELL, JOACHIM I. KRUEGER AND KATHLEEN D. VOHS

People intuitively recognize the importance of self-esteem to their psychological health, so it isn't particularly remarkable that most of us try to protect and enhance it in ourselves whenever possible. What *is* remarkable is that attention to self-esteem has become a communal concern, at least for Americans, who see a favorable opinion of oneself as the central psychological source from which all manner of positive outcomes spring. The corollary, that low self-esteem lies at the root of individual and thus societal problems, has sustained an ambitious social agenda for decades. Indeed, campaigns to raise people's sense of self-worth abound.

Consider what transpired in California in the late 1980s. Prodded by State Assemblyman John Vasconcellos, Governor George Deukmejian set up a task force on self-esteem and personal and social responsibility. Vasconcellos argued that raising self-esteem in young people would reduce crime, teen pregnancy, drug abuse, school underachievement and pollution, and even help to balance the state budget, a prospect predicated on the observation that people with high self-regard earn more than others and thus pay more in taxes. Along with its other activities, the task force as-

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sembled a team of scholars to survey the relevant literature. The results appeared in *The Social Importance of Self-Esteem* (University of California Press, 1989), which stated that “many, if not most, of the major problems plaguing society have roots in the low self-esteem of many of the people who make up society.” In reality, the report contained little to support that assertion.

In 1995 Edward F. Diener and Brian Wolsic of the University of Illinois and Frank Fujita of Indiana University South Bend examined this possibility. They obtained self-esteem scores from a broad sample of the population and then photographed everybody, presenting these pictures to a panel of judges, who evaluated the subjects for attractiveness. Ratings based on full-length photographs

Findings even suggest that artificially boosting self-esteem may lower performance.

The California task force disbanded in 1995, but a nonprofit organization called the National Association for Self-Esteem (NASE) has picked up its mantle. Vasconcellos, until recently a California state senator, is on the advisory board.

Was it reasonable for leaders in California to start fashioning therapies and social policies without supportive data? Perhaps, given that they had problems to address. But one can draw on many more studies now than was the case 15 years ago, enough to assess the value of self-esteem in several spheres. Regrettably, those who have been pursuing self-esteem-boosting programs, including the leaders of NASE, have not shown a desire to examine the new work, which is why the four of us recently came together under the aegis of the American Psychological Society to review the scientific literature.

In the Eye of the Beholder

Gauging the value of self-esteem requires, first of all, a sensible way to measure it. Most investigators just ask people what they think of themselves. Naturally enough, the answers are often colored by the common tendency to want to make oneself look good. Unfortunately, psychologists lack good methods to judge self-esteem.

Consider, for instance, research on the relation between self-esteem and physical attractiveness. Several studies have generally found clear positive links when people rate themselves on both properties. It seems plausible that physically attractive people would end up with high self-esteem because they are treated more favorably than unattractive ones—being more popular, more sought after, more valued by lovers and friends, and so forth. But it could just as well be that those who score highly on self-esteem scales by claiming to be wonderful people all around also boast of being physically attractive.

showed no significant correlation with self-esteem. When the judges were shown pictures of just the participants’ unadorned faces, the correlation between attractiveness and self-esteem was once again zero. In that same investigation, however, self-reported physical attractiveness was found to have a strong correlation with self-esteem. Clearly, those with high self-esteem are gorgeous in their own eyes but not necessarily to others.

This discrepancy should be sobering. What seemed at first to be a strong link between physical good looks and high self-esteem turned out to be nothing more than a pattern of consistency in how favorably people rate themselves. A parallel phenomenon affects those with low self-esteem, who are prone to floccinaucinihilipilification, a highfalutin word (among the longest in the Oxford English Dictionary) but one that we can’t resist using here, it being defined as “the action or habit of estimating as worthless.” That is, people with low self-esteem are not merely down on themselves; they are negative about everything.

This tendency has certainly distorted some assessments. For example, psychologists once thought that people with low self-esteem were especially prejudiced. But thoughtful scholars, such as Jennifer Crocker of the University of Michigan at Ann Arbor, questioned this conclusion. After all, if people rate themselves negatively, it is hard to label them as prejudiced for rating people not like themselves similarly. When one uses the difference between the subjects’ assessments of their own group and their ratings of other groups as the yardstick for bias, the findings are reversed: people with *high* self-esteem appear to be more prejudiced. Floccinaucinihilipilification also raises the danger that those who describe themselves disparagingly may describe their lives similarly, thus furnishing the appearance that low self-esteem has unpleasant outcomes.

Given the often misleading nature of self-reports, we set up our review to emphasize objective measures wherever possible—a requirement that greatly reduced the number of relevant studies (from more than 15,000 to about 200). We were also mindful to avoid another fallacy: the assumption that a correlation between self-esteem and some desired behavior establishes causality. Indeed, the question of causality goes to the heart of the debate. If high self-esteem brings about certain positive outcomes, it may well be worth the effort and expense of trying to instill this feeling. But if the correlations mean simply that a positive self-image is a result of success or good behavior—which is certainly plausible—there is little to be gained by raising self-esteem alone. We began our two-year effort by reviewing studies relating self-esteem to academic performance.

School Daze

At the outset, we had every reason to hope that boosting self-esteem would be a potent tool for helping students. Logic suggests that having a good dollop of self-esteem would enhance striving and persistence in school, while making a student less likely to succumb to paralyzing feelings of incompetence or self-doubt. Modern studies have, however, cast doubt on the idea that higher self-esteem actually induces students to do better.

Such inferences about causality are possible when the subjects are examined at two different

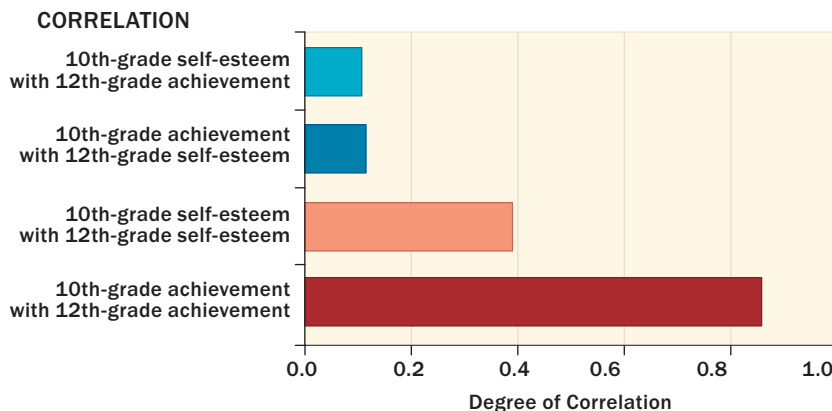
times, as was the case in 1986 when Sheila M. Pottebaum and her colleagues at the University of Iowa tested more than 23,000 high school students, first in the 10th and again in the 12th grade. They found that self-esteem in 10th grade is only weakly predictive of academic achievement in 12th grade. Academic achievement in 10th grade correlates with self-esteem in 12th grade only trivially better. Such results, which are now available from multiple studies, certainly do not indicate that raising self-esteem offers students much benefit. Some findings even suggest that artificially boosting self-esteem may lower subsequent performance.

Even if raising self-esteem does not foster academic progress, might it serve some purpose later, say, on the job? Apparently not. Studies of possible links between workers' self-regard and job performance echo what has been found with schoolwork: the simple search for correlations yields some suggestive results, but these do not show whether a good self-image leads to occupational success, or vice versa. In any case, the link is not particularly strong.

The failure to contribute significantly at school or at the office would be easily offset if a heightened sense of self-worth helped someone to get along better with others. Having a good self-image might make someone more likable insofar as people prefer to associate with confident, positive individuals and generally avoid those who suffer from self-doubts and insecurities.

Good Feelings, Good Grades?

In an attempt to gauge whether high self-esteem leads to good academic performance, researchers surveyed thousands of high school students in their sophomore and senior years. The correlation between self-esteem sophomore year and academic performance senior year proved to be about the same as the correlation between academic performance sophomore year and self-esteem senior year. Thus, it is hard to say that either trait helps the other or whether some third factor gives rise to both high self-esteem and superior achievement.



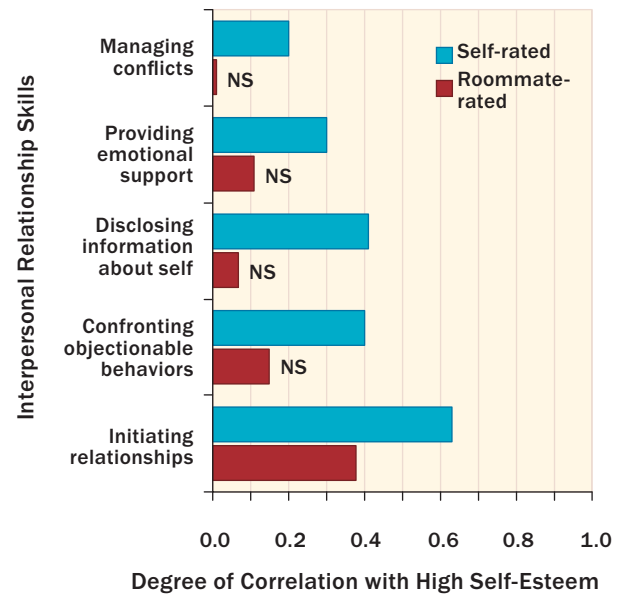
SOURCE: S. M. Pottebaum, T. Z. Keith and S. W. Ehly in *Educational Research*, Vol. 79, pages 140–144; 1986



Initiating Relationships



A study of college students revealed strong links between self-esteem and various interpersonal skills—when the subjects rated themselves. Ratings by their roommates provided a different picture: for four of the five skills surveyed, the correlations with self-esteem fell to levels that were not significant (NS) statistically. Nevertheless, the connection between self-esteem and prowess in initiating relationships stayed reasonably robust, as one might expect.



SOURCE: D. Buhrmester, W. Furman, M. T. Wittenberg and H. T. Reis in *Journal of Personality and Social Psychology*, Vol. 55, pages 991–1008; 1988

People who regard themselves highly generally state that they are popular and rate their friendships as being of superior quality to those described by people with low self-esteem, who report more negative interactions and less social support. But as Julia Bishop and Heidi M. Inderbitzen-Nolan of the University of Nebraska–Lincoln showed in 1995, these assertions do not reflect reality. The investigators asked 542 ninth-grade students to nominate their most-liked and least-liked peers, and the resulting rankings displayed no correlation whatsoever with self-esteem scores.

A few other sound studies have found that the same is true for adults. In one of these investigations, conducted in the late 1980s, Duane P. Buhrmester, now at the University of Texas at Dallas, reported that college students with high levels of self-regard claimed to be substantially better at initiating relationships, disclosing things about themselves, asserting themselves in response to objectionable behaviors by others, providing emo-

tional support and even managing interpersonal conflicts. Their roommates' ratings, however, told a different story. For four of the five interpersonal skills surveyed, the correlation with self-esteem dropped to near zero. The only one that remained statistically significant was with the subjects' ability to initiate new social contacts and friendships. This does seem to be one sphere in which confidence indeed matters: people who think that they are desirable and attractive should be adept at striking up conversations with strangers, whereas those with low self-esteem presumably shy away, fearing rejection.

One can imagine that such differences might influence a person's love life, too. In 2002 Sandra L. Murray of the University at Buffalo found that people low in self-esteem tend to distrust their partners' expressions of love and support, acting as though they are constantly expecting rejection. Thus far, however, investigators have not produced evidence that such relationships are especially prone to dissolve. In fact, high self-esteem may be the bigger threat: as Caryl E. Rusbult of the University of Kentucky showed back in 1987, those who think highly of themselves are more likely than others to respond to problems by severing relations and seeking other partners.

Sex, Drugs and Rock 'n' Roll

How about teenagers? How does self-esteem, or the lack thereof, influence their love life, in particular their sexual activity? Investigators have

RANDY FARIS Corbis

(The Authors)

ROY F. BAUMEISTER, JENNIFER D. CAMPBELL, JOACHIM I. KRUEGER and KATHLEEN D. VOHS collaborated on a more technical paper on self-esteem published in *Psychological Science in the Public Interest* [see "Further Reading," on page 57]. Baumeister is Eppes Professor of Psychology at Florida State University. Campbell, formerly professor of psychology at the University of British Columbia in Vancouver, lives in Florida. Krueger is professor of psychology at Brown University. Vohs is assistant professor of marketing and logistics management at the University of Minnesota.

examined this subject extensively. All in all, the results do not support the idea that low self-esteem predisposes young people to more or earlier sexual activity. If anything, those with high self-esteem are less inhibited, more willing to disregard risks and more prone to engage in sex. At the same time, bad sexual experiences and unwanted pregnancies appear to lower self-esteem.

If not sex, then how about alcohol or illicit drugs? Abuse of these substances is one of the most worrisome behaviors among young people, and many psychologists once believed that boosting self-esteem would prevent such problems. The thought was that people with low self-esteem turn

to drinking or drugs for solace. The data, however, do not consistently show that low adolescent self-esteem causes or even correlates with the abuse of alcohol or other drugs. In particular, in a large-scale study in 2000, Rob McGee and Sheila M. Williams of the Dunedin School of Medicine at the University of Otago in New Zealand found no correlation between self-esteem measured between ages nine and 13 and drinking or drug use at age 15. Even when findings do show links between alcohol use and self-esteem, they are mixed and inconclusive. We did find, however, some evidence that low self-esteem contributes to illicit drug use. In particular, Judy A. Andrews and Su-

Mixed Messages

A 1999 study by Donelson R. Forsyth and Natalie A. Kerr, both then at Virginia Commonwealth University, suggests that attempts to boost self-esteem among struggling students may backfire. College students getting grades of D or F in a psychology course were divided into two groups, arranged initially to have the same grade-point average. Each week students in the first group received an e-mail message designed to boost

their self-esteem (*example at left*). Those in the second group received a message intended to instill a sense of personal responsibility for their academic performance (*right*).

By the end of the course, the average grade in the first group dropped below 50 percent—a failing grade. The average for students in the second group was 62 percent—a D minus, which is poor but still passing.

Group 1

WHAT CAUSES GOOD AND BAD GRADES?

Research suggests that when students get back their tests, they tend to lose confidence: they say things like "I can't do this," or "I'm worthless," or "I'm not as good as other people in college."

Other studies suggest, though, that students who have high self-esteem not only get better grades, but they remain self-confident and assured.

In fact, in one study researchers had students write down what "went through their minds" when they were trying to get better grades. Students who improved with each test were thinking:
"I can be proud of myself."
"I can do this."
"I am better than most of the other people in this school."
"I am satisfied with myself."

Students who did not improve were thinking:
"I'm ashamed of myself."
"I don't deserve to be in college."
"I'm worthless."

BOTTOM LINE: Hold your head—and your self-esteem—high.

Group 2

WHAT CAUSES GOOD AND BAD GRADES?

Research suggests that when students get back their tests, they tend to blame poor scores on external factors: they say things like "the test was too hard," or "the prof didn't explain that," or "the questions are too picky."

Other studies suggest, though, that students who take responsibility for their grades not only get better grades, but they also learn that they, personally, can control the grades they get.

In fact, in one study researchers had students write down what "went through their minds" when they were trying to get better grades. Students who improved with each test were thinking:
"I need to work harder."
"I can learn this material if I apply myself."
"I can control what happens to me in this class."
"I have what it takes to do this."

Students who did not improve were thinking:
"It's not my fault."
"This test was too hard."
"I'm not good at this."

BOTTOM LINE: Take personal control of your performance.

san C. Duncan of the Oregon Research Institute found in 1997 that declining levels of academic motivation (the main focus of their study) caused self-esteem to drop, which in turn led to marijuana use, although the connection was weak.

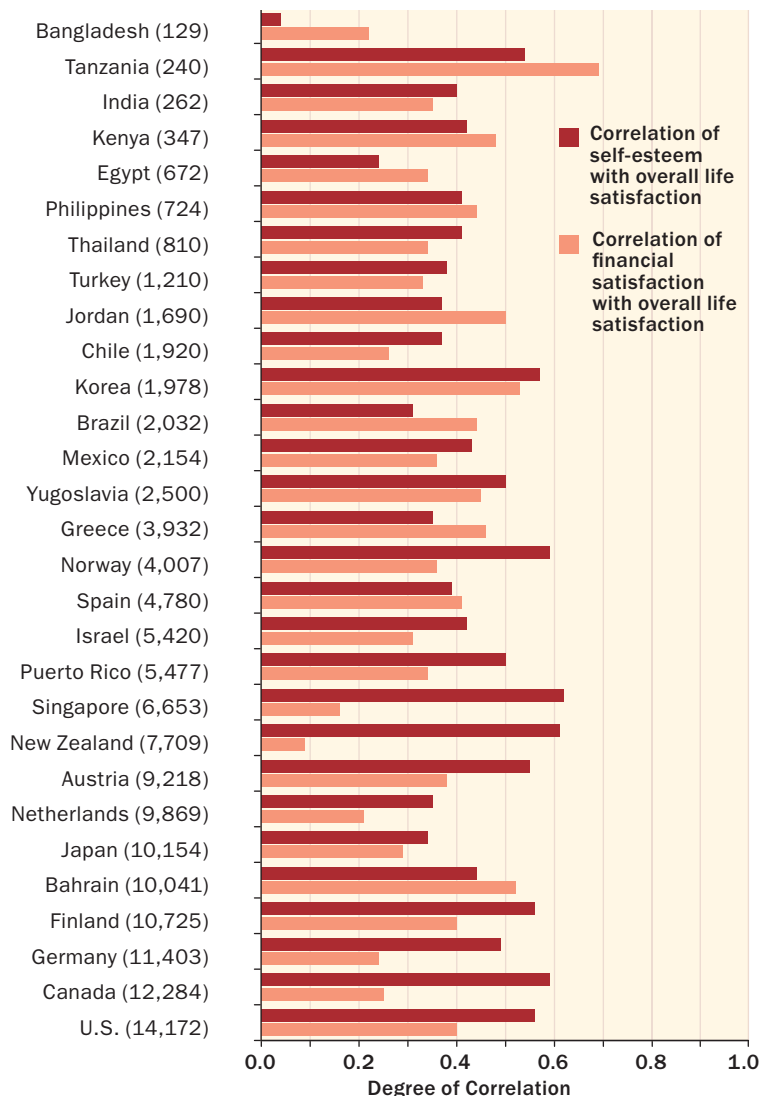
Interpretation of the findings on drinking and drug abuse is probably complicated by the fact that some people approach the experience out of curiosity or thrill seeking, whereas others may use it to cope with or escape from chronic unhappiness. The overall result is that no categorical statements can be made. The same is true for tobacco use, where our study-by-study review uncovered a preponderance of results that show no influence. The few positive findings we unearthed could conceivably reflect nothing more than self-report bias.

Another complication that also clouds these studies is that the category of people with high self-esteem contains individuals whose self-opinions differ in important ways. Yet in most analyses, people with a healthy sense of self-respect are, for example, lumped with those feigning higher self-esteem than they really feel or who are narcissistic. Not surprisingly, the results of such investigations may produce weak or contradictory findings.

Bully for You

For decades, psychologists believed that low self-esteem was an important cause of aggression. One of us (Baumeister) challenged that notion in 1996, when he reviewed assorted studies and concluded that perpetrators of aggression

Self-Esteem and Happiness



SOURCE: E. Diener and M. Diener in *Journal of Personality and Social Psychology*, Vol. 68, pages 653–663; 1995

A person's overall satisfaction with life tends to go hand in hand with his or her level of self-esteem, as shown by the high degree of correlation between the two. In most countries overall life satisfaction correlates better with self-esteem than with financial satisfaction. Exceptions tend to be countries with low per capita GDP (bracketed values, U.S. dollars).



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generally hold favorable and perhaps even inflated views of themselves.

Take the bullying that goes on among children, a common form of aggression. Dan Olweus of the University of Bergen was one of the first to dispute the notion that under their tough exteriors, bullies suffer from insecurities and self-doubts. Although Olweus did not measure self-esteem directly, he showed that bullies reported less anxiety and were more sure of themselves than other children. Ap-

(and its opposite, depression) has been studied mainly by means of self-report, and the tendency of some people toward negativity may produce both their low opinions of themselves and unfavorable evaluations of other aspects of life. Yet it is not clear what could replace such assessments. An investigator would indeed be hard-pressed to demonstrate convincingly that a person was less (or more) happy than he or she supposed. Clearly, objective measures of happiness and depression

Young people with high self-esteem are more prone to disregard risks and engage in sex.

parently the same applies to violent adults [see “Further Reading,” below].

After coming to the conclusion that high self-esteem does not lessen a tendency toward violence, that it does not deter adolescents from turning to alcohol, tobacco, drugs and sex, and that it fails to improve academic or job performance, we got a boost when we looked into how self-esteem relates to happiness. The consistent finding is that people with high self-esteem are significantly happier than others. They are also less likely to be depressed.

One especially compelling study was published in 1995, after Diener and his daughter Marissa, now a psychologist at the University of Utah, surveyed more than 13,000 college students, and high self-esteem emerged as the strongest factor in overall life satisfaction. In 2004 Sonja Lyubomirsky, Christopher Tkach and M. Robin DiMatteo of the University of California, Riverside, reported data from more than 600 adults ranging in age from 51 to 95. Once again, happiness and self-esteem proved to be closely tied. Before it is safe to conclude that high self-esteem leads to happiness, however, further research must address the shortcomings of the work that has been done so far.

First, causation needs to be established. It seems possible that high self-esteem brings about happiness, but no research has shown this outcome. The strong correlation between self-esteem and happiness is just that—a correlation. It is plausible that occupational, academic or interpersonal successes cause both happiness and high self-esteem and that corresponding failures cause both unhappiness and low self-esteem. It is even possible that happiness, in the sense of a temperament or disposition to feel good, induces high self-esteem.

Second, it must be recognized that happiness

are going to be difficult if not impossible to obtain, but that does not mean self-reports should be accepted uncritically.

What then should we do? Should parents, teachers and therapists seek to boost self-esteem wherever possible? In the course of our literature review, we found some indications that self-esteem is a helpful attribute. It improves persistence in the face of failure. And individuals with high self-esteem sometimes perform better in groups than do those with low self-esteem. Also, a poor self-image is a risk factor for certain eating disorders, especially bulimia—a connection one of us (Vohs) and her colleagues documented in 1999. Other effects are harder to demonstrate with objective evidence, although we are inclined to accept the subjective evidence that self-esteem goes hand in hand with happiness.

So we can certainly understand how an injection of self-esteem might be valuable to the individual. But imagine if a heightened sense of self-worth prompted some people to demand preferential treatment or to exploit their fellows. Such tendencies would entail considerable social costs. And we have found little to indicate that indiscriminately promoting self-esteem in today's children or adults, just for being themselves, offers society any compensatory benefits beyond the seductive pleasure it brings to those engaged in the exercise. **M**

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Myths persist in
modern culture
because of the
brain's biological
need to impose
order on the world

Likely Story

By
Klaus
Manhart

What is the best way to seduce a virgin so that neither she—nor your wife—notices? The Greek god Zeus devised a crafty plan after he observed the lovely Princess Europa gathering flowers by the sea and was immediately overcome by desire. Zeus took the form of a bull and walked gently over to Europa and let her pet him. ⚡ The bull seemed so peaceful to Europa that she trustingly climbed on his back—whereupon the animal plunged into the sea, absconding with the lady. After arriving at a far-off shore, Zeus transformed himself into a young man and appeared to Europa, promising to protect her forever in this new land, which he named in her honor. The ruse worked, and the couple had three sons together. ⚡ It seems the Greek gods could not do without a little heartache and intrigue now and then. Cloud-shrouded Mount Olympus was a sort



ZEUS
Supreme God

Rewarder of good
and punisher of evil,
Zeus ruled from
Mount Olympus with
law and the power
of thunderbolts.

GINA GORNY

DEMETER
Goddess of
Fertility

Sister and mistress
of Zeus, Demeter
brought fertility
to women and
bountiful harvests
to land.

GINA GORNY

of soap opera world. Its deified inhabitants set all kinds of traps for one another. They showed weakness, particularly for the beauty of the opposite sex. They also formed ad hoc alliances and fought and even killed in pursuit of their own interests. The gods were anything but perfect. Their human qualities go a long way toward explaining why myths from ancient Greece and elsewhere satisfy us to this day: if gods had hu-

90,000 years ago—whereas others have argued that Neandertals also may have developed a system of myths and religious beliefs.

Of course, the mythical systems of different human cultures vary greatly. But they all contain answers to the same fundamental questions. This was the conclusion reached by American myth researcher Joseph Campbell before his death in 1987. For decades, Campbell looked for common

Myths of different cultures all probe similar enigmas: life and death, creation and destruction.

manlike failings, then we humans can convince ourselves that we are capable of being godlike.

But there must be more to our attraction. Why is it so easy for us to buy into such mythology? In part, because certain functions of our brain insist on imposing order and purpose on our otherwise puzzling surroundings. No matter how rational and enlightened we attempt to be, our brains cannot resist the urge to embrace metaphysical relations.

Explain the Unexplainable

Myths are much more than soap operas. The earliest cultures used these fabulous stories to try to explain the mysterious natural phenomena that determined their existence. Ancient Egyptians conjured up hundreds of divinities who controlled the destiny of the Nile River and its peoples. The river's water, and its annual floods, embodied their ideas about creation, death and rebirth. According to beliefs of that era, the primeval ocean Nun filled the entire universe when life began. Just as the gods created life from Nun's waters, the flooding of the Nile left behind fertile wetlands that wondrous plants and animals colonized.

Initial forms of spiritual and religious practice trace back at least 40,000 years to a period many scholars associate with the emergence of modern human behavior [see "The Morning of the Modern Mind," by Kate Wong; *SCIENTIFIC AMERICAN*, June]. Numerous cave paintings and carvings from this period suggest that these people believed in powerful, supernatural forces, which they hoped to influence in their favor. Based on findings at archaeological sites such as Qafzeh in Israel, some researchers suggest that anatomically modern humans were taking part in burials and other rites even earlier—more than

motifs among a wide array of legends and religions from both ancient and modern societies, including Greek, Roman, Egyptian, Asian and Nordic.

Three qualities emerged: First, a myth involves an existential question about death, birth or the creation of the world. Second, a myth contains human conundrums raised by unbridgeable contradictions—creation versus destruction, life versus death, gods versus humans. Third, a myth attempts to reconcile these opposite poles, to allay our fears.

Brain Needs a Story

Over time, mythical stories become anchored in beliefs and religions, and today they continue to influence how people live and understand the world. The lore becomes a fundamental part of our cultural makeup, which is one reason why it persists, even in progressive and highly technological societies.

But perhaps there is more to the tale. In the late 1990s radiologist and religion researcher Andrew Newberg and psychiatrist Eugene G. d'Aquili, both then at the University of Pennsylvania, set out to find the wellspring of religious feelings in the brain. In 2001 Newberg published their groundbreaking results (d'Aquili had since passed away), based on monitoring the brain activity of meditating Buddhists and praying Franciscan nuns. As soon as their test subjects were in a deep state of religious contemplation, the researchers recorded drastically reduced activity in a particular part of the parietal lobe. This region

(The Author)

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	is responsible for spatial orientation and one's sense of body; it makes us conscious of where our own body ends and the rest of the world begins, so that we can clearly distinguish between ourselves and everything else. Newberg and d'Aquili postulated that religious feeling must have a neurological basis, because the lack of neuronal firing in this parietal region seemed to be associated with a sense of spiritual ecstasy. They concluded that religious impulse—an urge for metaphysical experience—was engraved in the brain. Other researchers have found that myths seem to have another biological foundation. In contrast	brain regions become involved. Together the eight operators regulate the work of the human mind. Though still being debated, this scheme is gaining more acceptance. The causal operator interprets reality as a chain of causes and effects. If the doorbell is ringing, someone is probably at the door. If it is raining, the street will be wet. The causal operator drives our curiosity and motivates us to decipher the mysteries around us. It enables us to develop empirical explanations for natural processes but also tries to create a cause-and-effect relation for metaphysical riddles such as death and the creation of the universe. People with certain types of	

(The brain's parietal lobe insists on conjuring up a cause and effect for metaphysical riddles.)

	to animals, humans have a capacity for abstraction, which allows us to imagine threats in advance. Physiological fear responses can be triggered simply by picturing a danger, which prepares the body for “fight or flight.” This same ability enables us to make sense of suffering and even of death. For example, we can rationalize that the pain of an immunization shot is worthwhile for the greater good of never catching measles. Bringing such observations together, d'Aquili coined the term “cognitive imperative” to describe this sense-making function of the brain. We have a biologically conditioned desire for order and sense. We simply cannot encounter situations and processes without ascribing purpose to them. Psychologists Michael E. McCullough of the University of Miami and the late David B. Larson, then at the National Institute for Healthcare Research, extended this concept to what they call ontological yearning—the need to understand the fundamental nature of our world rather than simply accepting it as is. According to this hypothesis, the cognitive imperative forces our brain to think unceasingly—and so we cannot help but make up stories and myths to account for the mysteries around us. Cosmic Cause and Effect The ability to conjure explanations for phenomena is a capacity that Newberg terms the causal operator. It is one of eight general, analytical functions of the brain, which Newberg and d'Aquili termed cognitive operators. When an operator is active, several, often widely separated	brain damage cannot trace even the simplest events to their causes. The other seven cognitive operators give a context for how and why the causal operator can emerge from our brain. The holistic operator allows us to see the world as a whole. With its help, we immediately and effortlessly understand a configuration of leaves, branches and twigs to be a tree. The holistic operator is based on activity in the right parietal lobe. The reductionist operator works in reverse; it makes it possible for us to break a whole into its component parts and is mainly based in the more analytical left hemisphere. The abstractive operator derives general concepts from individual facts. For example, it enables us to classify dachshunds, collies and cocker spaniels under a single rubric: dogs. Recent imaging studies indicate this function is based in the left parietal lobe. The existential operator gives us the feeling that data coming from our senses and processed by the brain have a basis in reality. This function is most likely based in the limbic system. The emotional operator lies there, too. It links perceptions to feelings and underlies our ability to think and judge rationally. The quantitative operator estimates size, quantity, time and distance and calculates mathematically. The binary operator helps us invoke order among the most varied phenomena in our environment. To perform this function, it meters space and time in terms of opposites: up and down, left and right, inside and outside, before and after. The binary operator is located in the	
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ARES God of War

Son of Zeus and Hera, Ares took pleasure in bloodshed. Soldiers dedicated their weapons to him before each campaign.

lower parietal lobe; patients with damage to this area can no longer identify the opposites of words or objects.

For Newberg and d'Aquili, the binary operator plays a crucial role in forming and perpetuating myths. It helps us reduce complex situations. It supplies us with a quick and simple heuristic for orienting ourselves, by constructing the central elements of myth: good and evil, birth and death, heaven and earth, isolation and integration.

Expanding the connection between cognitive operators and belief systems, Newberg and other researchers maintain that certain areas of the brain play a crucial role in religious experience.

Although this view continues to be controversial, it does seem clear that the ability to think in terms of cause and effect would not be possible without a particular functional structuring of the parietal lobe. In all probability, human beings seek explanations for the mysteries of the world simply because the brain has that capacity. **M**

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LUDVIK GLAZER-NAUDE
Images.com/Corbis

It's the first snow of winter. You step outside your front door to revel in the cold morning air, entranced by the falling flakes. Every object is still, blanketed in white. The landscape is deeply quiet. Suddenly your crotchety neighbor starts up his roaring snowblower, shattering your peace. Callous clod! You'd like to walk right over there and clobber him. But of course you don't. You step back inside, your moment of bliss ruined and your fury churning inside you.

YOUR ANGER!

Should you regulate your emotional reactions or let them rip?

By Iris Mauss

If a **gun-toting worker** or incensed driver lets his rage flow, catastrophic results are sure to follow.



Different cultures value various degrees of emotional control. For most Japanese, a calm exterior signals inner mental health. Westerners may interpret such stoicism as pretense or deception.

Whether they evoke joy or rage, calm or anxiety, glee or grief, the most commonplace events unleash manifold emotions within us. And we are almost constantly trying to control them. Virtually no reaction passes through our consciousness without alteration. We love to hear the boss praise us, but if our favorite colleague is in the room we downplay our joy as a way of appearing humble. If that same colleague says something particularly stupid, we bite our tongue to keep from laughing and making his plight worse. We humans are not just emotional animals: we are animals who control our emotions.

Researchers are interested in two questions here. First, why do we try to harness our feelings at all? We need them: anger gives us the courage to stand up to a threatening foe; sympathy prompts humans to help others. Second, how do we succeed in taming our emotions? Deeply rooted in our biological heritage, the animal inside us seems much stronger than any contrived mediation mechanism.

Death by Suppression

Psychologists, sociologists and anthropologists generally agree that we control our emotions—almost reflexively—because we have learned that knee-jerk reactions can hurt us. Emotions have their dark sides: anger can lead to violence; anxiety can lead to depression and that to suicide. As clinical psychologists now know, psychic disorders often result from exaggerated reactions that individuals can no longer control.

In addition, in today's technological world, out-of-control feelings can quickly lead to terrible consequences. If a gun-toting worker goes berserk or an incensed driver lets his rage flow through his accelerator pedal, catastrophic results are sure to follow. The ability to stay cool-headed appears to be necessary for survival.

How we exert such control, however, has baffled researchers for years. For one thing, even when we think we have our emotions under wraps, we may not. They may well be simmering just underneath the surface of our conscious

HOLOS Getty Images

How to Cool It

Anger is normal and acceptable when expressed appropriately. But out-of-control anger can hurt others, emotionally and even physically. Here are ways to cool off quickly if you are getting too hot.

From the American Psychological Association:
Breathe deeply, from your diaphragm.

Slowly repeat a calm word or phrase such as “relax” or “take it easy.”

Use imagery; visualize a relaxing experience, from either your memory or your imagination.

Rely on logic. In a heated discussion, slow down and think carefully about what you want to say.

Use humor. If you are about to call a colleague a dirtbag, imagine an actual bag filled with dirt sitting in his office chair.

From John F. Murray, sports psychologist, North Palm Beach, Fla.:

Use your anger to focus intensely on what you will do next rather than on what just made you angry.



When anger is overwhelming you, do anything to break the pattern: tie your shoelaces, count to 10, write a letter to your grandmother.

Turn your anger on yourself—that you are the one thinking negatively. Use this to transform negative thoughts into positive ones.

From Ayatullah Shaikh Abdulla Mamkani, Last Will and Testament (published by World Islamic Network):
Wash your hands and face with cold water.

If you are standing when you get angry, then sit down.
If you are sitting, then lie down.

From the Union Church, LaHarpe, Ill.:

Wait. Let yourself cool off before you speak. This will give you time to think rather than react.

Speak softly. Anger is fed by an increase in volume.

Attack problems, not people.

—Mark Fischetti

SOURCES: www.apa.org/pubinfo/anger.html, www.tennisserver.com/mental-equipment/me_8_96.html, www.al-islam.org/short/wasiyatnama/12.htm, www.unionchurch.com/archive/110898.html

minds. That, of course, is what Sigmund Freud believed. He bestowed on psychology the concept of repression: we shunt into our unconscious minds particularly painful feelings or those we cannot square with our ideals. Freud held that the psychic energy that is associated with those emotions, however, has to “go” somewhere, and it may vent in the form of neurotic or physical disorders.

Other researchers later reinforced Freud’s “hydraulic” hypothesis. In the 1930s Hungarian-born Franz Alexander, a pioneer of psychosomatic medicine, maintained that people who consciously stifle their feelings develop lasting high blood pressure. Or perhaps people with hypertension restrain their feelings. Alexander lacked an adequate way to measure emotions and

their control, so he could not pin down a cause-and-effect explanation.

Since then, psychologists have devised ways to manipulate emotions in the lab. James J. Gross of Stanford University investigates which control strategies work best and how they affect mental well-being and physical health. Several years ago he asked subjects to watch shocking, disturbing videos—one showing an arm amputation, another an African circumcision ritual. The volunteers were told not to look away. Gross instructed half of them to prevent their facial expressions from betraying their inner turmoil while they watched—they were to devote all their energies to maintaining a poker face. This type of self-control is called suppression. The other half of the subjects got no instructions about how to react.

Suppressors who swallow their irritation or sorrow are more prone to pessimism and depression.

Test subjects who let their emotions show while watching gruesome videos experienced just as much internal disgust as did subjects who were told to suppress their expressions.

During the tests, Gross filmed the subjects' faces and tracked such physiological data as heart rate, intensity of heartbeat and the electrical conductivity of their skin. All participants also filled out questionnaires asking how they had felt while watching the videos.

The poker-faced subjects, for the most part, succeeded in hiding outward signs of their feelings. The questionnaires indicated, however, that they had experienced no less disgust, horror or even fear than the subjects who had no special



instructions. And yet their autonomic nervous systems reacted especially strongly—an intense stress reaction—lending credence to the notion that controlling powerful feelings may be bad for your health.

Research done by various experts in the past five years shows that the negative effects of suppression are not limited to physical stress. As psychologists Roy F. Baumeister and Dianne M. Tice of Florida State University have demonstrated in recent studies, people who suppress their feelings are also less able to meet mental challenges. Jane Richards of the University of Texas at Austin discovered that suppressors had more difficulty remembering the details of emotionally significant experiences. Interpersonal relationships suffer, too. Emily Butler of the University of Arizona paired subjects with partners, some of whom were told not to show any sentiment during the pairs' conversations. The subjects judged the instructed people to be less sympathetic and interesting than other partners who had been given no directions.

Reining in emotions apparently has lasting consequences. In a 2003 study by Gross and Oliver John of the University of California, Berkeley, students were asked how much they tended to control their feelings in everyday life. They were then placed into two groups: people who express their emotions fairly openly and those who do not. The suppressors, who typically swallowed their irritation, fear or sorrow, were on average more pessimistic, more prone to depression and less self-confident. In addition, these students had fewer and less meaningful friendships. Keeping a cool demeanor seemed to entail considerable disadvantages.

Work by psychologist Johan Denollet of the University Hospital of Antwerp in Belgium confirms this view. Denollet questioned people who had suffered heart attacks about their "emotional habits." He wanted to know, for instance, how frequently they were in bad moods or had negative feelings such as dread, anger or regret. Did they share their feelings with others or keep them to themselves? When Denollet contacted the same patients 10 years later, in the early 2000s, to ask them the same questions, about 5 percent of the total had died. But of those who had originally reported greater-than-average levels of negative emotions or who had acknowledged a tendency to repress their feelings, a striking 25 percent were dead. Letting off steam, it seems, may literally save lives.

Monks in the Scanner

Denollet's findings leave us in a quandary. Psychology tells us that we cannot get along without containing our emotions, yet doing so leaves us socially isolated and physically ill. Fortunately, recent work has pointed to a way out of this dilemma. Emotional regulation does not have to lead to negative consequences if it is done right.

In the studies mentioned above, subjects had merely controlled their behavior, not the associated feelings themselves. If we can learn to see events in a different light, by changing our point of view, we can positively influence our feelings. Slow service in a restaurant might usually make us furious—but if we stop to realize that the poor waiter is overwhelmed by the number of customers, our resentment can dissipate.



Several researchers are now looking at how such cognitive emotional regulation operates—and if it can prevent the problems associated with suppression. People watching films of amputations could experience less trauma if encouraged to view the video with a detached, impersonal eye—say, to examine them as a doctor would.

This strategy was tested in 2002 by Kevin Ochsner of Columbia University, Silvia Bunge of the University of California, Davis, and John D. E. Gabrieli and Gross of Stanford. The neuropsychologists examined subjects with functional magnetic resonance imaging. This method, by detecting the oxygen content of blood, shows the relative amounts of activity in various brain regions. Ochsner and his colleagues showed subjects disturbing images of surgery, fatally ill children and lunging rottweilers. Some of the subjects were merely asked to watch the films, and the rest were told to distance themselves from the contents as much as possible, using strategies they had been taught and then practiced independently. The leading technique was to “reappraise” the

“stories behind the pictures”—for example, they were asked to imagine that a sick baby in a photo gets well again or that a snarling dog is really pretty far away, behind a high fence.

Ochsner and his colleagues found that subjects who could mentally distance themselves clearly registered more activity in the prefrontal cortex, a region responsible for so-called executive functions—everything having to do with planning, deciding and implementation. [For more on executive function, see “Brian Wilson: A Cork on the Ocean,” by Brian Levine, on page 36.] When frontal-lobe neurons were more activated, neurons were quieter in the limbic system, especially in the amygdala, which is involved in dealing with negative emotions. Cognitive strategies, it seems, can control emotional reactions. Subjects who coped well also described themselves as having experienced less nausea and dis-

An Inuit mother may let an upset baby cry, an early lesson that the Arctic society strongly disapproves of any display of negativity.

(The Author)

IRIS MAUSS is associate professor of psychology at the University of Denver, where she calmly investigates how people regulate anger.

(By learning to look at events in different lights,
we can **positively influence** our feelings.)

gust, and they demonstrated reduced activity in their autonomic nervous systems. As Shakespeare's Hamlet put it: "There is nothing either good or bad, but thinking makes it so."

The big question is whether such techniques work in stressful, real-life situations. Richard J. Davidson of the University of Wisconsin-Madison turned to Tibetan monks for an answer. The monks spend many hours a day in meditation for all their lives. An important Buddhist goal is to rid oneself of all negative feelings and think positively. Monks say that they feel much less anxiety, grief or annoyance than other people in society. In the past, some Tibetan monks who were threatened with torture by their Chinese occupi-

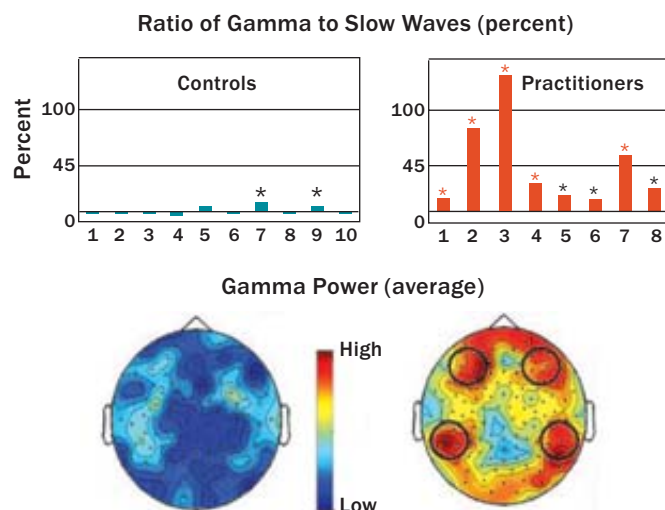
ers chose suicide by setting fire to themselves—with smiles on their faces.

To Davidson's good fortune, the Dalai Lama, the most important figure in Tibetan Buddhism, is very interested in neuroscience and several times in the past decade has brought together Buddhists, psychologists and neuroscientists. Using electroencephalograms, Davidson recorded the brain activity of eight veteran monks while they were practicing deep meditation. He then compared their brain waves with those of novices who had received only a week's training in meditation.

The longtime monks exhibited significantly higher levels of so-called gamma waves—which have frequencies ranging from 25 to 42 hertz and which appear during periods of increased awareness. The gamma-wave levels were greater than any ever reported in scientific literature, except in pathological cases. This effect was especially pronounced in two regions of the frontal lobes that are involved in the intellectual modulation of emotions. From Davidson's point of view, the activity was neuronal evidence of the monks' ability to master their feelings.

Masters of Emotion

People can learn to control their mental states and diffuse ill feelings by mastering emotions such as anger. Tibetan monks who are experts in meditation rid themselves of negativity by augmenting the brain's gamma waves. Eight monks (*practitioners graph, below*) whose brain waves were recorded boosted their gamma waves to two times (*black stars*) or three times (*orange stars*) the resting level. Eight volunteers (*controls graph, below*) with no meditation experience who were given a week of training showed little gain, although two had some success. The regions of greatest gamma activity (*bottom*) are shown in a composite head of each set of eight people.



Healthy Control

Different cultures offer various ways to successfully regulate emotions. Anthropologist Jean L. Briggs lived for many months in the early 1960s among the Utku, an Inuit tribe in the Canadian Arctic. She was amazed by how little discord existed among them. From long interviews with her hosts and observation of their daily lives, she determined that the Utku viewed with extreme disapproval the display of any negativity. Toddlers were simply ignored if they began to scream. An adult who raised his voice in rage was treated as an idiot or a danger to the community. Briggs (now professor emeritus at the Memorial University of Newfoundland in Canada) experienced such shunning herself once when she got mad at her host family; she immediately had to find a new place to stay.

Briggs's fieldwork resulted in a book, *Never in Anger* (Harvard University Press, 1970, republished in 2005), which has become a classic about the effective control of downbeat emotions. Critics have argued that the Utku may simply belong, en masse, to the segment of humans who suppress



Monks meditate hours a day to encourage only positive thinking. As a result, they say they feel less anxiety, grief or annoyance than other populations do.

emotions. But recent research reinforces the idea that customs and beliefs do affect the subjective experience of emotions—that emotions are not just biologically determined reactions.

Social psychologist Hazel R. Markus of Stanford compared the attitudes of Americans and Japanese in this regard. The norms of most Far Eastern cultures demand stronger individual limits on emotions than do those in the West. According to Markus's findings, Westerners see attempts at control as exercises in pretense or deception. Some also consider such efforts as a possible cause of physical ailments such as cancer or heart disease. For most Japanese, however, a calm exterior is a sign of inner mental and physical health, as well as satisfaction—a positive feeling that may buoy them against the strain of suppression. And the Japanese people are among the longest-lived populations on the earth. Whereas Americans tend to obey the exhortation to “let it out,” Japanese men and women generally prefer more calm emotional states and less emotional expression.

If societal and cultural influences can channel us from early childhood into learning the “right” methods, then in principle, any person with sound strategies could learn to deal with his or her emotions in a healthy way. Recall the over-

whelmed waiter. To prevent us from becoming livid, we could consider his position for a moment. The change in perspective can work wonders. Suddenly the short wait will not seem so significant—after all, we are not in a rush, and soon enough we will get our food. By using this type of strategy, we redirect unconstructive impulses. With practice we can begin to see more situations through other people's eyes, without having to stop and think about them.

Many questions remain. Why is regulating emotions so much harder for some people than for others? Which techniques are most effective? How exactly do we go about learning them? What can we adopt from other cultures? The message from science is hopeful: we are not helpless slaves of our emotions. We can gain the upper hand. **M**

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The Promise





of

Therapy

Videoconferencing, Web sites and other electronic media offer faster, cheaper care—without the stigma of parking in front of the shrink's office

By Beryl Lieff Benderly

AGE FOTOSTOCK

Clinician Bobby Jordan (*left*) and Sheila Musharbash, Mobile Crisis Team director, discuss a client by teleconference with nurse Floyd Hutson at the ICU of Scott County Hospital in Tennessee.



A sheriff's deputy pulls up to the emergency room at Scott County Hospital in rural Oneida, Tenn., with an agitated, disoriented passenger who appears to need psychiatric care, maybe even immediate hospitalization. But no one at the county hospital is trained to make that decision. The nearest qualified person is 59 miles across the state, at the Ridgeview Psychiatric Hospital in Oak Ridge.

Only a few years ago a member of Ridgeview's Mobile Crisis Team would have driven for 90 minutes, mostly over winding back roads, to Oneida. During that long wait, the distressed patient could not receive needed treatment, and the ER would have had to deal with a possibly disruptive individual. But today when a call comes from Scott County, the Ridgeview clinician takes a much shorter trip, to a nearby room equipped for videoconferencing.

Back at the ER, a staffer accompanies the patient to a room fitted with similar equipment. An average of 13 minutes after the emergency room phones Ridgeview, the patient's evaluation gets under way. The medium may be different, but "it's the same evaluation," with no apparent difference in clinical results, says Sheila Musharbash, the Mobile Crisis Team's director. What is more, according to evaluation studies conducted

as part of the federally funded research project that has supported the videoconference service since 2001, the 300-plus patients who have undergone the procedure have declared themselves very satisfied with the results.

Cutting the wait for emergency evaluations at Scott County is only one of the changes that new communications devices are bringing to mental health care. Psychiatrists, psychologists and counselors now use e-mail, handheld computers, computerized telephone systems, Web sites and streaming video. They treat conditions such as anxiety, addiction and post-traumatic stress disorder in patients who, in many cases, would otherwise not get care or would receive treatment less suited to their needs. Various called e-therapy, telemedicine and telehealth, the practice has been growing over the past 15 years. Its full extent is not definitively known, however.

Though still often occurring in experimental settings, e-therapy is "moving forward, and it's going to become part of the mainstream," says social worker Ann Miller. Miller is vice president of clinical services at CRC Health, the parent company of eGetgoing, which offers counseling via the Internet to recovering alcoholics around the world. Miller and other proponents claim that technology is surmounting such major barriers to mental health care as distance, schedul-

ing, stigma and cost. Before Miller's prediction can come true, however, supporters will have to overcome some significant clinical, ethical and administrative issues as well as the skepticism of many peers. The American Psychiatric Association (APA), for example, "supports the use of telemedicine as a legitimate component of a mental health delivery system to the extent that its use is in the best interest of the patient and is in compliance with the APA policies on medical ethics and confidentiality," according to an official statement of position—a rather tepid en-

tional factors prevents kids from having normal bowel movements, and the resulting chronic constipation, accompanied by frequent accidents, comes to dominate their families' lives. A team at the University of Virginia School of Medicine "developed a behavioral treatment that works in combination with medical management," says Lee Ritterband, a psychologist with training in computers. "We said, 'Okay, we've got this treatment that works. Let's see if we can get it out to people because there are so few people in the country who know how to deal with it.'"

“The medium may be different, but it’s the same evaluation,” one proponent says.

dorsement. A number of professional organizations in the mental health community are currently working to define ethical and responsible remotely delivered practice. Meanwhile organizations such as the International Society for Mental Health Online and the International Society for Research in Internet Interventions have been formed to advance knowledge in the field.

Nevertheless, for Jay Shore, a psychiatrist at the University of Colorado Health Sciences Center and at Veterans Administration medical centers in several cities, high-tech treatment is already the norm. Only four of his 20 weekly clinical hours are traditional face-to-face psychiatry. The rest involve patients hundreds of miles away. For the past three years, he has conducted weekly group therapy via videoconference for Vietnam veterans with post-traumatic stress disorder who live on the Rosebud Sioux Reservation in South Dakota. Similar clinics have also been organized by the Veterans Administration at reservations in Wyoming and Montana. Without these sessions, Shore says, "at least half would be getting no treatment" because they could not regularly drive seven hours to Denver. Like rural communities everywhere, their reservations largely lack specialized mental health facilities. Some of his patients "might get some treatment locally," he adds, "but probably not specifically tailored to veterans."

Overcoming Barriers

Finding expert care for undertreated conditions is challenging even in big cities. Few clinicians, for example, effectively treat pediatric encopresis, a condition affecting 3 to 6 percent of children. A combination of physical and emo-

The Internet provided the perfect platform. The group's Web site, www.ucanpoooptoo.com, offers a four-week program of structured activities, complete with animated cartoon characters and video games, that a child and parent work through together. (The giggle-provoking "Super Clean-Out" game lets the youngster empty a cartoon bowel by blasting incoming stools, Space Invaders-style.) Families who enroll in a clinical study after referral by a physician or psychologist receive free, password-protected access. The group also has in the works adult-oriented Internet interventions to treat insomnia and aid glucose control in type 1 diabetes.

Even for more widely treated conditions, however, travel difficulties, stigma and other issues that surround making and keeping appointments often limit traditional care. A study provided substance abusers in a metropolitan area access to both in-person counseling sessions and online counseling via e-mail. Of those people, only "something like 30 percent" chose to show up "for the first visit face-to-face," says Farrokh Alemi of the George Mason University nursing school, whose research focuses on substance abuse treatment programs. Many more of them chose to go online, and "something like 82 percent [of the entire group] was still online six

(The Author)

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months later”—a “really striking” difference, he adds. In outcome data from eGetgoing’s alcohol recovery groups, which participants attend at set times but from computers of their own choosing, “80 percent of the first 100 people completed the 24 sessions” of the program, Miller says, although the literature on face-to-face treatment shows that generally “the dropout rate of outpatient treatment runs from 40 to 70 percent.”

Therapy via phone line, broadband connection or palmtop computer can also negate the often crucial barrier of stigma. “In smaller communities, where they know what car you drive—if

about 20 patients.” Face-to-face counseling, he adds, often plays a limited role in the lives of clients who—because of cost, lack of transportation, scheduling problems or other obstacles—are able to see a counselor only periodically. But with the technology, “our data show that a counselor can handle a lot more.” He notes that patients “now have a provider that appears to them, whether by e-mail or telephone, every day.”

Judging Results

But how well do such therapies work? “You can do most of the things that we as psychiatrists

Teletherapy can cross national borders, but licenses to practice medicine and psychology do not.

you’re parked outside [a mental health facility], they’re going to know” why you’re there, says health evaluation expert Susan Dimmick of Oak Ridge Associated Universities. In larger communities, people may resist needed treatment to protect personal or professional standing. The concern for privacy, Miller suggests, is a major reason that eGetgoing counts many impaired professionals, such as doctors and lawyers, in its addiction treatment program.

Tech-assisted care also has a great potential for cutting costs, proponents argue. In ongoing studies conducted by Michelle G. Newman and her colleagues at Pennsylvania State University, people with generalized anxiety disorder who receive behavioral and cognitive therapy via handheld computers were found to need fewer hours of in-office counseling. Several times each day for 12 weeks, the computer prompts clients to report their level of anxiety and then do appropriate breathing, relaxation and cognitive restructuring exercises. “A lot of these techniques are easy to master, but they’re also easy to do wrong,” says Amy Przeworski, a doctoral candidate in psychology who works on the project. Done incorrectly, the breathing method “can essentially lead to hyperventilation, which makes for more anxiety.” But the tiny computer, she notes, can walk the patients through the procedure.

Projects using e-mail and computerized callback systems to keep in touch with low-income substance abusers also show how caregivers can extend their reach, Alemi says. With traditional methods, “typically a counselor can handle

and mental health providers do in person pretty successfully,” Shore says. Clinicians have to make some subtle changes in their approach, however, to compensate for the loss of cues provided by face-to-face contact. Still, the men in his long-distance groups have “made the same type of progress, I feel, that they would have made in person.”

Formal research on the topic is still scattered but tends to support Shore’s subjective impression. Preliminary findings from the Penn State anxiety study, for example, suggest that “the computer works as well as face-to-face therapy, but face-to-face therapy is going to be a lot more expensive,” Przeworski says. Alemi adds that in a study of pregnant women addicted to cocaine, a group that received online services, a chat room, a voice mailbox and home monitoring showed as much recovery as a group that received face-to-face therapy.

The Virginia encopresis study did even better, producing a “very, very significant” change that “almost solved the problem,” Ritterband says. Before treatment the children, on average eight years old, were having about an accident a day, between six and eight accidents a week. Four weeks later the control group that did not use the Web site but “continued with their pediatrician were still having about eight accidents a week.” The youngsters using the Web site were having an accident only once every two weeks.

But, cautions Russ Newman, executive director for professional practice at the American Psychological Association, much more research is needed to determine “under what conditions, for

Getting Together Apart

It's 6:30 P.M. in the San Jose, Calif., office of addiction counselor Leslie Washburn as he welcomes group members and me to eGetgoing's regular Wednesday meeting for alumni of intensive alcohol treatment. But I'm not on the West Coast. I see his smile and hear his voice on my computer in Washington, D.C. A list of screen names appears below his live picture as the members arrive—Henry logs in from Alaska, Valerie from Cairo, Egypt, and others from New Jersey and towns elsewhere in California. (To protect privacy, all names are pseudonyms.)

Interest, concern, approval and sympathy play across Washburn's face as the members, using microphones, take turns recounting the week just past. Only Washburn's face appears, but the members' voices brim with emotion—pleasure at improving health, for example, or frustration over joblessness. Those listening use icons to agree, disagree, applaud, laugh or request a turn.

Amy reports an especially rough time—a fractured



The Internet brings a therapist (center) to computer screens of participants in a real-time group session, depicted here in a conceptual collage. Patients (surrounding photographs) converse using microphones.

As the hour's end nears, Amy apologizes for hijacking the agenda. Nonsense, says Henry, as applause icons flash. "The core of this group is to help each other with day-to-day recovery." Others urge Amy to persevere and promise that she will be in their thoughts until next week. Washburn—who alone knows each person's real identity—says he will phone Amy to talk privately right after sign-off. "Leslie and group," Amy says, "you know I couldn't get along without you." —B.L.B.

what problems and with which interventions, do you get quality health care?" The new technologies, he adds, "are not one thing" and need to be evaluated individually.

They also raise many questions. Start-up funding is often a major challenge, and most projects to date have relied on research grants. Insurance coverage is spotty at best. Videoconference connections and the Internet cross state lines and national boundaries, but licenses to practice medicine and psychology do not. Establishing identity and guarding confidentiality in cyberspace takes special care. Long-distance therapy requires clinicians to make careful emergency plans involving the resources available in the patient's area in case problems arise. Nor is tech-assisted therapy right for some patients, such as those at risk for self-harm or who need supervision. Many practitioners thus remain wary. It is not clear whether the objections mostly reflect concerns about the value of using electronics or worries that, as Przeworski says, "they're going to lose their jobs" because technology will replace "what we do as psychologists or physicians."

Nevertheless, proponents see tremendous—

and sometimes unexpected—potential benefits. In Scott County, Dimmick says, sheriff's deputies who know they will not have to kill hours waiting for evaluations are more willing to bring troubled individuals to the hospital rather than the jail and involve the mental health rather than the criminal justice system. Telemedicine can "bring [mental health care] back not only to the patients' community but into their homes and really revolutionize the model of health care," Shore says. And as for names, Newman suspects, the time will come when the new techniques simply "will be called psychotherapy." **M**

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Left Out

The world is designed for right-handed people. Why does a tenth of the population prefer the left?

By Detlef B. Linke and Sabine Kersebaum

When ancient Roman seers conducted their magical rituals, they would face north. East—to the right—represented luck and positive omens. The west—to the left—was the dark realm of the dead. The Bible tells of the good sheep who, on Judgment Day, will find comfort at the Savior's right hand, while the sinners at his left will be condemned to eternal damnation.

The division between right and left, between good and evil, persists in today's idiomatic expressions: a "left-handed compliment" is really no compliment at all; someone with "two left feet" is clumsy on the dance floor. Yet someone's "right-hand man" is always there for him. We vilify the left, thanks to centuries of derision by the right-handed majority. Across cultures, right-

ies outnumber lefties nine to one. What causes such a glaring disproportion? The answer lies between the hemispheres of the brain.

Genes, Perhaps

As with many fundamental human traits, scientists are immediately drawn to genes for explanations. The probability that two right-handed people would have a left-handed child is only about 9.5 percent. The chance rises to 19.5 percent if one parent is a lefty and 26 percent if both parents are left-handed. The preference, however, could also stem from an infant's imitation of his parents. To test genetic influence, starting in the 1970s British biologist Marian Annett of the University of Leicester hypothesized that no single gene determines handedness. Rather, during fetal development, a certain molecular factor helps to

BRUCE FORSTER Getty Images

strengthen the brain's left hemisphere, which increases the probability that the right hand will be dominant, because the left side of the brain controls the right side of the body, and vice versa. Among the minority of people who lack this factor, handedness develops entirely by chance.

Research conducted on twins complicates the theory, however. One in five sets of identical twins involves one right-handed and one left-handed person, despite the fact that their genetic material is the same. Genes, therefore, are not solely responsible for handedness.

Genetic theory is also undermined by results from Peter Hepper and his team at Queen's University in Belfast, Ireland. In 2004 the psychologists used ultrasound to show that by the 15th week of pregnancy, fetuses already have a preference as to which thumb they suck. In most cases, the preference continued after birth. At 15 weeks, though, the brain does not yet have control over the body's limbs. Hepper speculates that fetuses

had undergone difficult births. They also found many more lefties who had learning disorders and epilepsy. Common neurological ailments were more prevalent among twins than singles, and twins had a higher incidence of left-handedness.

In 1982 renowned Boston neurologist Norman Geschwind floated a theory that handedness was driven by the body's own immune system. The idea occurred to him while attending a conference on reading and writing disorders; people with such difficulties reported an unusually high occurrence of immune system problems or migraine headaches in their families. With further research, Geschwind discovered that left-handed people are two and a half times more likely to suffer from allergies, reading and writing handicaps, skeletal abnormalities, stuttering, and thyroid illnesses—a constellation of effects dubbed the Geschwind syndrome. Other researchers conducting similar studies, however, have failed to find such links, casting doubt on Geschwind's theory.



There is little science to prove that lefties are more creative than righties, yet among famous artists lefties are particularly prevalent: Greta Garbo (*left*), Matt Groening and Spike Lee.

tend to prefer whichever side of the body is developing quicker and that their movements, in turn, influence the brain's development. Whether this early preference is temporary or holds up throughout development and infancy is unknown.

Brain Damage—Not

Genetic predetermination is also contradicted by the widespread observation that children do not settle on either their right or left hand until they are two or three years old. This fact dismisses, finally, the socially disparaging theory that lefties are lefties as a result of some kind of brain damage—a position that some scientists maintained as recently as two decades ago. In the 1920s researchers indicated that there was a rather high incidence of left-handedness among children who

One-Sided Argument

But even if these correlations were true, they did not explain what actually causes left-handedness. Furthermore, specialization on either side of the body is common among animals. Cats will favor one paw over another when fishing toys out from under the couch. Horses stomp more frequently with one hoof than the other. Certain crabs motion predominantly with the left or right claw. In evolutionary terms, focusing power and dexterity in one limb is more efficient than having to train two, four or even eight limbs equally. Yet for most animals, the preference for one side or the other is seemingly random. The overwhelming dominance of the right hand is associated only with humans.

That fact directs attention toward the brain's

SUNSET BOULEVARD/CORBIS (Garbo); FRED PROUSER Reuters/Corbis (Groening); NICOLAS GUERIN Azimuts Production/Corbis (Lee)

Forced to Switch

Left-handed people “squint, they stammer, they shuffle and shamble. They flounder about like seals out of water. Awkward in the house and clumsy in their games. They are fumbler and bunglers at whatever they do.” That is how Cyril Burt described lefties in 1937. And he was a child psychologist. Today we would be quick to refute such drastic words, and yet people in many cultures still view left-handers as disadvantaged by nature.

The practical difficulties many lefties exhibit, however, are largely the result of a right-handed culture that has designed scissors, can openers, circular saws, guitars, golf clubs and computer mice to suit its orientation. It is therefore understandable that left-handers, especially young children, may appear at first glance to be less capable.

For generations, this mistaken view prompted parents and teachers to force naturally left-handed children to “switch” to the right hand. It is impossible to know how many closet lefties are making their way in the world today, although estimates indicate 5 to 25 percent of lefties are unnaturally favoring their right.

Some psychologists think that when a left-handed child is forced to do everything with the right hand, the brain’s balance of power can become confused. The dominant right hemisphere is relegated to a more subservient role, while the left hemisphere becomes overburdened. As a result, communication between the two halves also suffers; information transfer through the corpus callosum, which connects the two hemispheres, breaks down.



The same psychologists claim that this situation can potentially compromise memory and concentration, not to mention disturb the language function. Some studies indicate that children who have been forced to switch are more likely to experience speech or reading and writing disorders. They also run the risk of suffering from inferiority complexes.

Happily, the practice of switching children from left hand to right is nearly extinct. Special schoolroom implements and educational materials are readily available. Opinions differ, however, about restorative training for adults. Members of certain left-hander organizations say adults should be trained back to their originally dominant hand, arguing that the move will reduce stress on the brain. But it is not easy to rewire an adult’s nervous system, and many people question whether the frustrating task is worth the trouble.

—D.B.L. and S.K.

two hemispheres and perhaps toward language, which in most people is clearly seated in one hemisphere or the other. Perhaps left- and right-handedness is unbalanced because the brain’s functions are divided asymmetrically. In our daily lives this unequal distribution is hardly recognizable, yet each hemisphere possesses particular strengths and weaknesses.

Interest in hemispheres dates back to at least 1836. That year, at a medical conference in Montpellier, France, physician Marc Dax reported on an unusual commonality among his patients. During his many years as a country doctor, Dax had encountered more than 40 men and women for whom speech was difficult, the result of some kind of brain damage. What was unique was that every individual suffered damage to the left side of the brain. At the conference, Dax elaborated on his theory, stating that each half of the brain was responsible for certain functions and that the left hemisphere controlled speech. Other experts

showed little interest in the Frenchman’s ideas.

Over time, however, scientists found more and more evidence of people experiencing speech difficulties following injury to the left brain. Patients with damage to the right hemisphere most often displayed disruptions in perception or concentration. Major advancements in understanding the brain’s asymmetry were made in the 1960s as a result of so-called split-brain surgery, developed to help patients with epilepsy. During this operation, doctors severed the corpus callosum—the nerve bundle that connects the two hemispheres. Unhinging the halves prevented an uncontrolled neurological firing in one part of the brain—the start of an epileptic episode—from ex-

(The Authors)

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Is Your Baby a Lefty?



Nature may decide whether we become left-handers or right-handers, but environment may influence genetic predisposition, too. A child may adopt his parents' handedness even if that is contrary to his own biological leanings.

Most parents are eager to recognize which hand their baby is favoring. And most parents think they can discern a preference early on, perhaps from the way a child reaches for objects or uses a spoon or paintbrush.

But it is easy to be fooled. Babies may experiment with one hand for a while, then try the other. Experts say children usually do not consistently favor one side until they are two or three years old. Some children may remain ambidextrous until they are five or six and then choose. —D.B.L. and S.K.

ploding into a brainwide storm that caused terrible seizures. But the surgical cut also stopped almost all normal communication between the two hemispheres, which offered researchers the opportunity to investigate each side's activity.

After many experiments on split-brain patients, neuroscientists determined that both hemispheres can perceive, learn and remember independently, although the type of processing and the level of performance vary. The left side was particularly strong in analytical functions such as language processing, whereas the right side was better equipped to handle spatial and musical tasks. The left hemisphere processed sensations and thoughts as discrete elements, whereas the

right hemisphere preferred to interpret such inputs as a single whole.

As understanding grew, it became clear that differences between the hemispheres mean little for healthy people. Every bit of information that enters one half of the brain is available to the other half via the corpus callosum. For higher functions such as learning, in particular, both halves work in concert. The primary exception is language.

Language—Half the Story

In 1949 neurosurgeon Juhn Wada devised the first test to provide access to the brain's functional organization of language. By injecting an anesthetic into the right or left carotid artery, Wada temporarily paralyzed one side of a healthy brain, enabling him to more closely study the other side's capabilities. Based on this approach, Brenda Milner and the late Theodore Rasmussen of the Montreal Neurological Institute published a major study in 1975 that confirmed the theory that country doctor Dax had formulated nearly 140 years earlier: in 96 percent of right-handed people, language is processed much more intensely in the left hemisphere. The correlation is not as clear in lefties, however. For two thirds of them, the left hemisphere is still the most active language processor. But for the remaining third, either the right side is dominant or both sides work equally, controlling different language functions.

That last statistic has slowed acceptance of the notion that the predominance of right-handedness is driven by left-hemisphere dominance in language processing. It is not at all clear why language control should somehow have dragged the control of body movement with it. Some experts think one reason the left hemisphere reigns over language is because the organs of speech process-

Left-handed painters may tend to place characters or objects symmetrically, as in Leonardo da Vinci's *The Last Supper*. Right-handers may favor asymmetrical relationships.



BETTINA SALOMON Photo Researchers, Inc. (top); TED SPIEGEL Corbis (bottom)

ing—the larynx and tongue—are positioned on the body's symmetry axis. Because these structures were centered, it may have been unclear, in evolutionary terms, which side of the brain should control them, and it seems unlikely that shared operation would result in smooth motor activity. Small physiological details could have tipped the scales in favor of the left hemisphere, such that an impulse from the left brain would reach the right vocal cord faster, giving the left brain an advantage in producing language.

Language and handedness could have developed preferentially for very different reasons as well. For example, some researchers, including evolutionary psychologist Michael C. Corballis of the University of Auckland in New Zealand, think that the origin of human speech lies in gestures. Gestures predated words and helped language emerge. If the left hemisphere began to dominate speech, it would have dominated gestures, too, and because the left brain controls the right side of the body, the right hand developed more strongly.

Creativity in Hand

Perhaps we will know more soon. In the meantime, we can revel in what, if any, differences handedness brings to our human talents. Popular wisdom says right-handed, left-brained people excel at logical, analytical thinking. Left-handed, right-brained individuals are thought to possess more creative skills and may be better at combining the functional features emergent in both sides of the brain. Yet some neuroscientists see such claims as pure speculation.

Leonardo da Vinci is perhaps the most famous lefty of all. Researchers disagree on how much his handedness drove his creativity. Proponents note that he had a propensity to paint holistic and symmetrical settings. He grouped people in centered, pyramidal structures. In his famous painting *The Last Supper*, he situated the apostles around the table in a way that makes an observer view the group as an integrated whole. Their body postures focus the eye toward the middle, where Jesus sits. Right-handed artists such as Rembrandt, in contrast, seem to prefer more asymmetrical relationships—for example, grouping trees in the lower left-hand corner of a canvas while extending a green mountain landscape out to the right.

Some of these observations may be little more than wild speculation. Leading the way is the story of Alan M. Turing, the mathematician who is widely credited with founding modern computer theory before his death in 1954. Some analysts see Turing as a poster boy for psychologist Geschwind's

view that left-handedness, and resulting mathematical creativity, stems from immune system dysfunction. Turing was extremely allergic to pollen, wearing a gas mask to protect himself on his daily bicycle ride to the University of Cambridge.

Fewer scientists are ready to claim that left-handedness means greater creative potential. Yet lefties are prevalent among artists, composers and the generally acknowledged great political thinkers. Possibly if these individuals are among the left-

Chimps Choose, Too

Wild chimpanzees prefer to use their left hands as they delicately insert twigs in holes to "fish" for termites. This propensity demonstrates that the brain specialization necessary for handedness was present in the common ancestor of chimpanzees and humans, says Elizabeth V. Lonsdorf, a primatologist at Lincoln Park Zoo in Chicago. In 2005 Lonsdorf reviewed 67 hours of videotape taken of five wild chimpanzee families in Tanzania's Gombe National Park and observed that not only were most young chimps left-handed but that they inherited hand preference from their mothers. Whether this behavior is genetically or socially determined remains to be seen.



—Kaspar Mossman

ies whose language abilities are evenly distributed between hemispheres, the intense interplay required could lead to unusual mental capabilities.

Or perhaps some lefties become highly creative simply because they must be more clever to get by in our right-handed world. This battle, which begins during the very early stages of childhood, may lay the groundwork for exceptional achievements. Then again, lefties with bilateral language processing could represent a new evolutionary advance for *Homo sapiens*, in which creative constellations between the hemispheres are being tested. Lefties might like to raise that notion the next time a right-hander puts them down. **M**

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The collision damaged his forebrain.
Surgeons saved it.
But they never checked his pituitary,
and he is no longer the man he was

PERSONALITY CRASH

By Felicitas Witte

The sun had just risen as Dan Shelby began pedaling his bicycle down a main thoroughfare in Philadelphia. The computer programmer had to get to work early, and the traffic was still light. Seeing no oncoming cars, he quickly stuck out his arm as a signal and made an abrupt left onto the cross street.



He hadn't spotted the sedan already bounding up that road into the intersection, right at him. Dan's head crashed into the windshield, and he crumpled to the pavement, unconscious and bleeding.

This is how witnesses describe the accident of September 17, 2002 (names and locations of this real case have been changed). Despite the bike helmet, Shelby's brain was so damaged that he fell into a coma. He had severe craniocerebral trauma (CCT)—widespread injury to the brain and its nerves, especially to the frontal lobes. Half of all patients with severe CCT die within

sight is more common than the medical community realizes. And it is an understandable lapse: after all, doctors are attempting to save these patients' lives; most hormonal glands are just not that critical.

What Wife?

After several surgeries, ongoing treatment in the intensive care unit stabilized Shelby's brain and body. He emerged from the coma after 20 days, and many weeks later he was transferred to a rehab clinic. There he could not remember the accident or anything from the days prior to it. He

(After the accident Dan was **easily irritated** yet dissolved into tears at the slightest conflict.)

several hours. Many of those who do not will stay in the coma and, if they come out, may have serious losses of memory and other mental functions. Shelby's doctors did not know if he would emerge or what shape his brain would be in. Unfortunately, his case was not unique: bike, car and other violent accidents cause CCT in tens of thousands of victims each year.

Within hours Shelby's neurosurgeons recognized that the cyclist had suffered a frontal brain contusion with cerebral hemorrhage. They quickly began operating to relieve surging fluid and inflammation in the affected area. The fact that a pea-size gland deep in the interior of his head was also damaged escaped them. That over-

did remember what was going through his head when he first regained consciousness: he heard a small band playing Christmas music.

As rehab progressed, day by day Shelby felt as though his life was beginning again. Each bit of progress was a quiet triumph. But Shelby's wife had a hard time sharing his joy. Despite her daily visits, her husband did not recognize her. She was shocked when he asked who she was. Shelby's psychological functions were sluggish; his emotions seemed random. Such symptoms are common in CCT victims, and Mrs. Shelby tried to be patient, showing excitement as her husband learned to walk and brush his teeth again. After a trying six months, Shelby did manage to piece together some recognition of his family and former life. His doctors sent him home, and he looked forward to reestablishing relationships with his wife and two young daughters.

But the much anticipated normalcy did not return. The family experienced a husband and father who was a changed man. He was easily irritated yet dissolved into tears at the slightest conflict, and one morning he became so enraged that he threw his coffee cup at the wall. His wife found he had virtually no libido and could not keep an erection. After frustrating attempts to fire up their love life, the couple agreed to a platonic relationship.

During this period Shelby continued to go to rehab and started occupational therapy—mental exercises intended to gradually restore the capabilities he needed to resume his programming job. There he realized that he could barely concentrate. He frequently interrupted whichever

FAST FACTS

Pituitary Damage

1>> Neurosurgeons have many life-threatening complications to resolve in patients who have undergone a violent blow to the head. The doctors can easily overlook hard-to-spot signs of trauma to the pituitary gland deep in the brain.

2>> The pituitary controls the release of numerous hormones. People with untreated pituitary damage can have significant hormone imbalances and may therefore seem to take on new personalities. Many lose their libido, become irritable, fly into rages and yet also quickly fall into despair. They often have difficulty planning and making judgments.

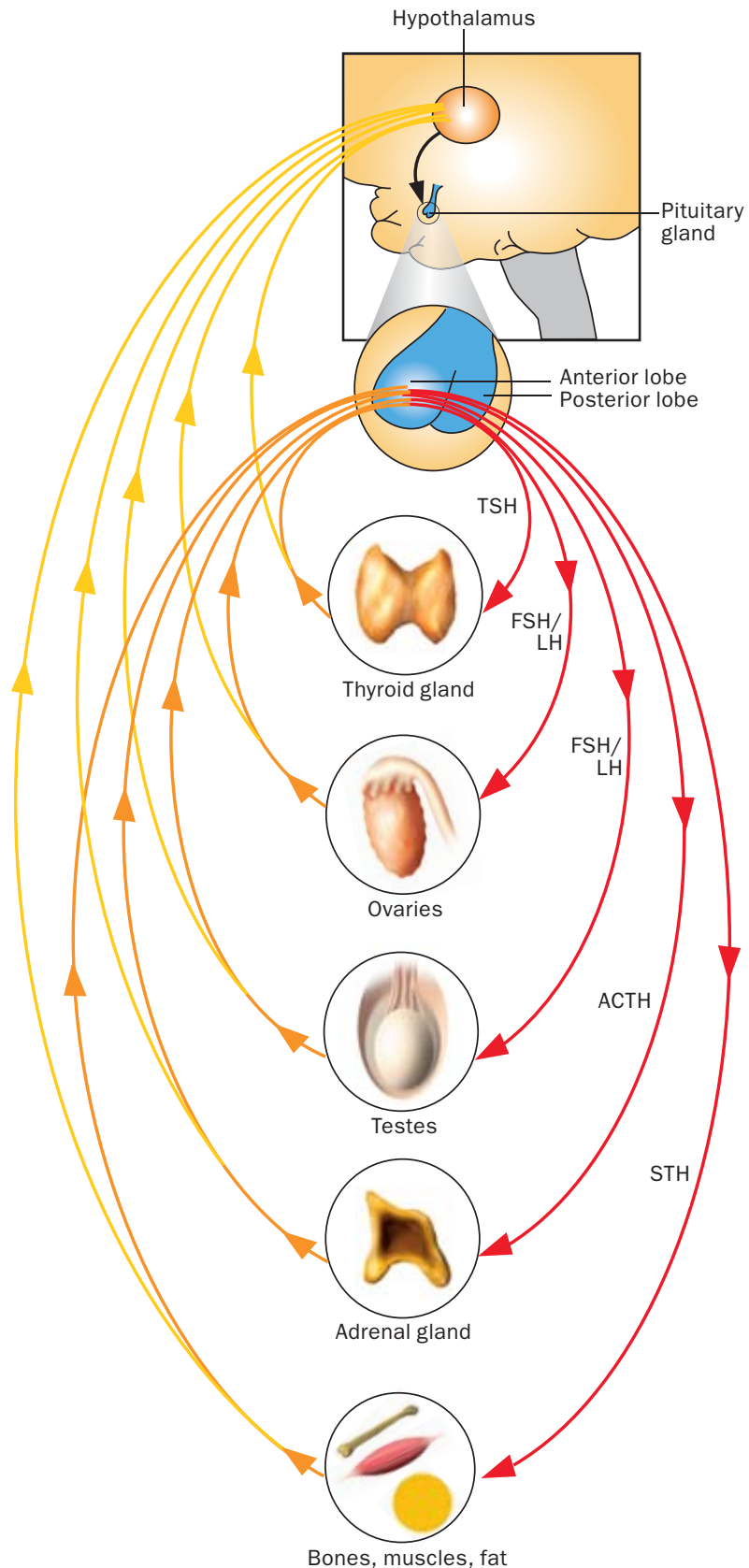
3>> Simple blood tests can determine if the pituitary has been compromised. Hormone therapies can restore balance and bring patients back to their old selves again.

Gland Master

The pea-size pituitary gland is located at the base of the brain. This “master gland” releases hormones (red arrows) that command other glands and organs crucial to basic bodily functions such as growth, temperature regulation and blood pressure. The glands and organs send feedback (orange arrows) to the pituitary and to the brain’s hypothalamus (yellow arrows), which instructs the pituitary to raise or reduce its output of a given hormone. Injury to the pituitary can cause these physical and psychological complications:

- Low output of thyroid-stimulating hormone (TSH) to the thyroid gland can reduce the body’s metabolic rate, possibly causing weight gain, shivering, fatigue or dry skin, and can prompt emotional mood swings.
- Deficiencies in follicle-stimulating hormone (FSH) and luteinizing hormone (LH) can undermine development of female eggs and male sperm, as well as reduce libido and bring on depression.
- Too little adrenocorticotrophic hormone (ACTH) to the adrenal gland can lead to weakness, fatigue, apathy or anxiety.
- Growth hormones such as somatotrophic hormone (STH) control the production of muscle, bone and fat. Extreme shortages during development can result in dwarfism, oversupply in gigantism. Deficiencies in adults may cause apathy or depression and affect concentration power.
- The pituitary’s posterior lobe secretes antidiuretic hormone, which regulates water retention by the kidneys, and oxytocin, which causes uterine contractions and affects mammary gland stimulation (*hormones not shown*).

—F.W.





Pituitary damage can cause hormone deficiencies that leave victims incapable of sustaining relationships or handling stress.

therapist was speaking and then talked without stopping. He forgot what other people told him, and he got mad over minor hurdles.

Shelby's wife had an increasingly hard time handling her husband's change in personality. His memory of their relationship gradually returned, but he was still emotionally absent. She withdrew and, in the autumn of 2003, asked for a separation. Shortly thereafter Shelby moved into an apartment near downtown. Though sad, break-ups are not uncommon after such a severe accident. Indeed, Shelby's case was somewhat typical for CCT patients. Damage to the frontal lobes in particular can lead to disorders in drive and behavior. Patients are virtually incapable of planning anything and have trouble judging the con-

sequences of their own actions. They tend toward wild mood swings and, like little children, have a hard time controlling their anger. Many relationships cannot survive such a change.

Hormone Failure

A year after the accident Shelby began work again at his old company, on a reduced schedule. His co-workers were understanding; at first he was to focus on simple programs and small projects. But unlike before, the highly trained professional was no longer self-motivated and could not seem to figure out what needed to be done first. He had great difficulty completing his assignments.

Shelby asked his doctors frequently about his symptoms, but they told him the same thing each time: he was suffering from the usual late consequences of CCT. But Shelby could not reconcile himself to his condition. After two years he had had enough. His work was terrible; his sex life was unsatisfactory. He insisted to his doctors that

(The Author)

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GETTY

something was not right. They readmitted him to a hospital.

Curious about the sexual dysfunction, doctors determined that Shelby had almost no testosterone, the male sex hormone. Surprised, they sent him for further hormone screening. The findings: several of his major glands were underproducing, and their deficiencies were all linked to the tiny pituitary gland at the foundation of his

Furthermore, hormone metabolism is almost always disturbed in the days following a severe accident, and the chaos does not necessarily have anything to do with trauma to the pituitary. For example, most women miss their menstrual cycle after CCT or other major head injuries. The production of thyroid hormones or growth hormones can also be inhibited because the brain cuts back on all metabolic processes that are not crucial to

(Thanks to **hormone therapy**, Dan is his old self again, despite occasional limitations.)

brain. This “master gland” releases hormones that command other glands and organs crucial to basic bodily functions. Low pituitary output was depressing Shelby’s thyroid gland, in turn depressing his metabolism and making his emotions erratic. The sagging pituitary also suppressed his adrenal gland, leaving him fatigued, and limited his growth hormones, oddly enough reducing his concentration. And it cut his sex hormones, erasing his libido and triggering bouts of crying and depression. The doctors finally understood that the pituitary had been damaged in the accident, and it was releasing very little of the crucial messenger molecules that direct other hormonal systems of the body.

Because the pituitary gland is sheltered deep within the brain, physicians rarely think to look there for trauma. Until recently, it was the medical consensus that damage to the region was a rare complication of CCT, according to Guenter Stalla, an internist and neuroendocrinologist at the Max Planck Institute for Psychiatry in Munich. Few researchers had investigated this phenomenon, although a look back at the limited studies does show that people who died from CCT had impaired pituitary glands. And in recent investigations, researchers have found massive hormone disturbances in a third or more of CCT patients.

Stalla worries that many people who have recovered physically from CCT may be walking around with significant psychological, behavioral or relationship problems because their pituitary ills remain undiagnosed. Simple blood tests can determine if the master gland is compromised, but many physicians do not consider pituitary deficiencies because hormone levels do not play much of a role in the acute phase of treatment after an accident.

life. Generally, however, the body starts producing these hormones again after a few weeks.

Shelby’s doctors might have been unconsciously figuring on that very trend. But ignoring a hormone deficiency could have fatal consequences, leaving the body unable to handle severe stress and perhaps allowing a traumatically sick person to die of shock, Stalla warns. Stalla and other neurologists are beginning to study how a doctor can recognize whether a patient is suffering from a debilitating pituitary disturbance. So far the investigators have found abnormally low levels of at least one hormone group in five of 17 head trauma patients, indicating that pituitary insufficiency may be more frequent than previously thought. In response, Stalla recommends that physicians test hormone levels of patients three months after an accident. Monthly tests thereafter may help rule in or rule out pituitary damage.

Once Shelby’s hormone trouble had been diagnosed, he was given thyroid hormones, growth hormones, cortisol and sex hormones, and doctors continue to monitor those levels regularly to this day. Shelby says he has finally gotten back his original zest for life. And even though he sometimes notices mental limitations, he says he is also his old self at work again. He socializes in the evening, meets friends, plays sports and sees his daughters often. Now 40, Shelby has not yet found a new partner. But he is happy to be leading a nearly normal life. He is even riding to work, more cautiously, on his bike again. **M**

(Further Reading)

- ◆ **Neuroendocrine Dysfunction in the Acute Phase of Traumatic Brain Injury.** Amar Agha et al. in *Clinical Endocrinology*, Vol. 60, No. 5, pages 584–591; May 2004.
- ◆ The Pituitary Society offers information on disorders and doctors at www.pituitarysociety.org/public

Learning to Focus

A few simple tricks can help children (and adults) improve their concentration powers

BY CHARMAINE LIEBERTZ



“YOU HAVE TO CONCENTRATE!” Who among us never heard that exhortation in grade school or from our parents? Of course, it is genuinely difficult for children to ignore distractions and dedicate themselves to a task at hand. Yet school counselors and cognitive therapists see the inability to concentrate as a widespread learning problem. Some straightforward steps can improve concentration power—for students and adults.

Parents can first help children learn how to concentrate by being good role models. If you are working on an assignment or proj-

ect, show your children what you are doing and how you will break the task into manageable pieces. Then let them know why you do not want to be disturbed.

When it is the child’s time to work, show them how to implement a few simple rules. Most important is to create an optimal work environment—a quiet space devoid of distractions such as background music, television images, conversations, toys, and sibling and pet traffic. The stimulus filters in the brain—the thalamus and the limbic system—are not always able to screen out such disturbances.

GETTY IMAGES

If a task is complex, such as a huge jigsaw puzzle or a time-consuming construction project for school, help children figure out how to divide up the work. Explain the value of focusing and completing one piece at a time, instead of trying to grapple with the entire job at once. After the student is under way, he or she may be quite content to work independently, converting what was just learned into his or her own persistence. Remember that a child's capacity to concentrate is considerably less than that of an adult, so adjust your expectations and possible criticism accordingly.

Quiet Rules

Other tactics, noted below, will also be handy. Adults might consider adopting the measures as well. Too often we fail to follow such simple and time-honored tips. We allow ourselves to be bombarded with interruptions and check e-mail too frequently, believing we can juggle many tasks simultaneously. It is an illusion to think that we can parcel out our attention so finely. Recent research has demonstrated that our brains really can't handle multitasking effectively—doing different things in parallel, with the same level of concentration toward each demand [see “The Limits of Multitasking,”

Games to Improve Concentration

Story detective One person in a small group tells or reads a story containing numerous details. She then asks a series of questions: What animals, persons, objects and colors were mentioned? Where was the house that was robbed located? What time did the main character come home? A logic error can be built into the story, too; the first person to recognize it gets to tell the next story.

Concentration Six to eight players stand in a circle. One player displays a body movement. The next player repeats it, adding another movement. Each subsequent player repeats the prior movements and adds a new element. If that seems too easy, create a movement and sound simultaneously; for example, nod and whistle.

Restaurant One person, the waiter, approaches a group of two or three others and mentally notes orders that those players place, choosing from objects visible in the room (one magazine, two red pencils, one lamp). When the waiter remembers the orders successfully, another player takes over that role.

—C.L.

SCIENTIFIC AMERICAN MIND, Premier Issue, 2004].

Motivation. Before beginning a work session, ask yourself why you want to take on the particular task. Your motivation will increase as soon as you are clear about the goal and payoff, which in turn will keep you focused. Concentration disorders in children are often motivational problems in disguise. Consider that many students claim it is hard to memorize vocabulary lists, even though they have no trouble retaining the complicated names of Pokémon characters or dinosaurs.

Emotional tugs. Tumultuous feelings can readily divert your attention. Try listing all these feelings on a piece of scrap paper—just writing down the words can clear the distractions from your mind.

Diet. When our brains work hard, they burn large quantities of the sugar glucose. A steady nutritional supply throughout the day, from more frequent but smaller meals of foods such as fruit, yogurt and full-grain bread, may improve your focus better than the blood-sugar spikes and dips associated with heavy meals and long fasts in between, especially if you are consuming sugary drinks, cakes and white breads.

Physical activity. Frequent physical activity increases oxygen and glucose supplies to the brain. If you have been sitting at a desk for too long and feel you are fading mentally, get up and take a walk.

Praise. After a productive spell of concentration, praise yourself. Even more so, praise your child. The brain's reward centers will produce dopamine, eliciting a sense of happiness, which will encourage even greater focus next time. **M**

CHARMAINE LIEBERTZ has a doctorate in educational science and is head of the Association for Holistic Learning, a training institute in Cologne, Germany.

Balance the Senses

Our capacity to focus and think develops primarily during the first 10 years of life, becoming firmly established as a result of mental, emotional and motor experiences. The human brain learns only gradually how to filter the flood of incoming stimuli and select the most important information.

But a boy or girl who sits constantly in front of a television or computer game shapes his or her neural networks differently than a peer who primarily plays physical games with friends or reads books. In today's information society, a child's sight and hearing senses are often overstimulated, while other fundamental channels of perception such as touch may remain underdeveloped. This imbalance can prevent children from learning how to process information correctly, making it even harder for them to concentrate. Parents and educators should therefore make sure that children are exposed to a well-balanced sensory palette early on.

—C.L.

Magic, Mystery or Mechanism

Sweet Dreams: Philosophical Obstacles to a Science of Consciousness

by Daniel C. Dennett. MIT Press, 2005 (\$28)



Consciousness puzzles scientists and philosophers as much as it baffles the rest of us. Elusive, enigmatic, and difficult to define and probe, consciousness has a peculiar quality that rouses people to insist that somehow it differs from the rest of the physical world and that there is something unique about each person's subjective experience.

Enter Daniel Dennett, a philosopher who directs the Center for Cognitive Studies at Tufts University. In his provocative book, he explores several hot debates over whether consciousness can ever be explained—such as our inability to objectively study subjective

experiences or “qualia,” the impenetrable properties of sensations. Despite our stubborn feelings that consciousness involves something extra—a spirit, soul, miracle or magic—Dennett contends that consciousness is no more than an intriguing but inadequately explained aspect of neural activity.

“Consciousness is often celebrated as a mystery,” he writes. “I think this tradition is not just a mistake, but a serious obstacle to ongoing scientific research that can explain consciousness, just as deeply and completely as it can explain other natural phenomena: metabolism, reproduction, continental drift, light, gravity and so on.” Like a persuasive magic show, consciousness fools us into believing that the brain's seamless illusion is real, even though consciousness is a purely biological phenomenon.

To make his point, Dennett works

through various thought experiments. One involves imagining a “perfect zombie” that exactly replicates a person's perceptual and neural processes. Should there be any real difference between the zombie and the conscious person, he wonders? He also attacks the claim that a mechanistic theory of consciousness could not explain such a difference, if it existed. Another thought experiment involves imagining Martian scientists studying human consciousness. In principle, he says, Martians should be able to observe and inspect the mechanisms underlying earthly conscious experiences and, in some sense, grasp what it is like to be human.

In time, Dennett believes people will realize that “third-person methods of the natural sciences suffice to investigate consciousness as completely as any phenomenon in nature can be investigated.” Like vitalism—the 18th-century belief that some inexplicable force animates living creatures—consciousness will ultimately yield to scientific explanation. —Richard Lipkin

Mind Reads

Making Himself Happy

Satisfaction: The Science of Finding True Fulfillment

by Gregory Berns. Henry Holt and Company, 2005 (\$24)

Gregory Berns believes that the striatum, a tiny bit of tissue in the lower brain, holds the key to satisfaction in life. Berns, who teaches psychiatry and behavioral sciences at Emory University, is interested in what motivates people to seek out novel experiences as a way to achieve satisfaction—a process, he says, controlled by the striatum.

Yet it is surprising and disappointing that such a prolific researcher and author of scholarly articles has chosen to entertain readers with exploits rather than science. Only a few short sections of *Satisfaction* focus on his own work, so we get little understanding of how neuroscience is done. Explaining brain anatomy, chemistry and psychology to a general audience is a huge challenge—and one Berns does not really meet. Each chapter has a few pages of hard science but then describes at length a visit by Berns to an exotic location or an event that illustrates how people strive to meet extreme challenges as a way of attaining satisfaction.

In one chapter, Berns flies to the Sierra Nevadas to observe ultramarathoners run for hours over mountain trails, which he then uses to write about brain metabolism and ex-

haustion. His other trips—to a volcano in Iceland and to a sadism and masochism club near his home in Atlanta, for example—follow the same pattern. These jaunts reach a high (or low) point when he ends up in a Long Island, N.Y., kitchen, his feet immersed in warm lemon juice and fennel, waiting for a chocolate cake to come out of the oven—as the chef reads Jorge Luis Borges's poetry to him in Spanish.

The final chapter is somewhat embarrassing. Berns confesses that while he has “jetted around” he has left his wife at home with “few sources of adult stimulation” and two toddlers. In addition, he complains that their sex life has become “routine.” He finds a solution in the “sexual crucible,” a program developed by a Colorado marital therapist. The result is a night of lovemaking that pleases him in a way that he equates with an ultramarathoner's high. Some readers may fall in love with Berns's quests for novelty; others may find no satisfaction here. —Jonathan Beard



The Hard Problem

Conversations on Consciousness: What the Best Minds Think about the Brain, Free Will, and What It Means to Be Human

by Susan Blackmore. Oxford University Press, 2005 (\$22)

The question “What is consciousness?” provokes all kinds of responses, ranging from jokes about psychedelic drugs to brow-furrowing discourses on life’s meaning. Nearly everyone has an opinion, despite the lack of meaningful data explaining the phenomenon.

Susan Blackmore posed this question to 21 leading scientists and philosophers who study consciousness for a living, compiling their responses into lively, though slightly repetitive, Q&A interviews. In each case, Blackmore asks, What’s the problem with consciousness? Why does it differ from other targets of scientific inquiry? Several thinkers insist that it does not and that researchers will fare better when they treat consciousness like anything else in nature. Others assert that consciousness is fundamentally different, constituting something extra beyond the ordinary physical world. Says David Chalmers, an Australian mathematician-turned-philosopher: “The

heart of the science of consciousness is trying to understand the first-person perspective”—to explain subjective experiences objectively.

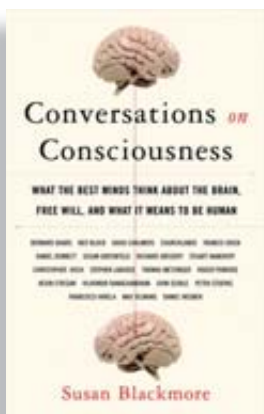
In grappling with what neuroscientists call the “hard” problem—the struggle to explain how neural processes create subjective experiences—the experts are long on theories but short on answers. Nearly all agree that classical dualism doesn’t work—that the mind and brain cannot be made of distinct

substances. Many refer instead to the neural correlates of consciousness, the neural activity present during a person’s conscious experience.

Blackmore queries the thinkers on such issues as life after death, the self and free will. Most say they do not believe in extracorporeal survival, in contrast with 55 percent of U.S. residents. Most also agree that scientific evidence does not support the notion of free will, despite the gripping feeling that it exists. And because the search for the source of a conscious “I” in the brain has turned up empty, the existence of a distinct self seems remote, although subjective awareness suggests each person needs a self to experience consciousness.

Blackmore also asks the researchers why they chose to study consciousness and how doing so has affected their lives. Several refer to a fascination with altered states of consciousness prompted by drugs, meditation, dreams or anesthesia. Many abandoned fruitful research careers in other areas to pursue the Holy C. Perhaps the most extreme case is that of Francis Crick, a physicist who won the Nobel Prize by decoding DNA’s structure and then at age 60 turned his attention to consciousness work for a quarter of a century. Crick’s interview by Blackmore was his last; he died shortly thereafter, in July 2004.

—Richard Lipkin



Brain Disease as Mental Slavery

72 Hour Hold

by Bebe Moore Campbell. Alfred A. Knopf, 2005 (\$24.95)

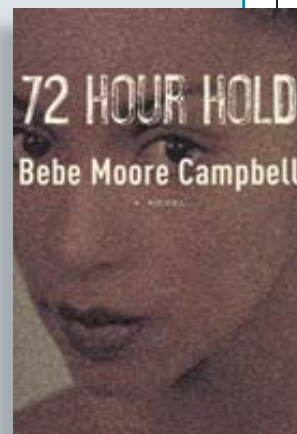
“Hell, being black is hard enough.... Please don’t add crazy.” So writes Bebe Moore Campbell in her compelling new novel that confronts two taboo subjects in the African-American community: mental disorder and homosexuality. The book is named for the three-day maximum period that a mentally ill adult can be legally held in a public health facility if she demonstrates a danger to herself or others. The novel tells the story of Keri Whitmore, a successful black businesswoman struggling to care for a teenage daughter with bipolar disorder, which causes radical mood swings between mania and depression.

The fictional prose is not meant to offer an inside look at brain disease. Rather it presents a brutally honest and devastating account of a mother’s love and the desperate degree to which she will go to rescue her child from mental illness. In doing so, Campbell exposes the woeful inadequacies of our current public health care system in treating such patients and introduces the novel’s greatest value: its insight into the challenges faced by people who must care for such loved ones.

Nevertheless, this noble effort is undermined when Campbell invokes slavery to convey the horrors of mental illness. Though poignant, the comparison seems forced, relying on overwrought passages about whipping posts and slave auctions. The metaphor clouds the novel’s purpose, especially since the author seems to decide, by the end, that the best way to deal with a family member’s brain disease is through acceptance rather than emancipation. The same cannot be said of slavery. Campbell also draws parallels between brain disorders and homosexuality to suggest that both issues must be dealt with more openly. Her point that both are unfairly stigmatized is overshadowed by the unsavory implication that being gay is a malady somehow akin to mental illness.

The novel offers important lessons to family members about caring for the self and seeking the support of others. And yet Campbell’s main character is overly ambitious, much like the book itself. Keri seems more like a wonder-mom with an endless supply of time, energy and patience than a desperate mother on the brink of collapse. She not only cares for her manic daughter but runs her thriving business, strokes the ego of her workaholic ex-husband, counsels her boyfriend’s gay son and advises a drug-addicted ex-prostitute. Then again, Campbell has taken on ambitious aims, which she accomplishes with some success despite the novel’s distractions.

—Jeanne Hamming



asktheBrains

Do we really use only 10 percent of our brains?



Barry L. Beyerstein, a psychologist in the Brain Behavior Laboratory at Simon Fraser University, Burnaby, B.C., offers this answer:

PERHAPS IT IS UNWELCOME news, but neuroscience has found no vast, unused cerebral reservoir for us to tap. In addition, a study of self-improvement products by a National Research Council panel found that no “brain booster” is a reliable substitute for practice and hard work when it comes to getting ahead in life.

Why would a neuroscientist immediately doubt that 90 percent of the average brain lies perpetually fallow? First of all, it is obvious that the brain, like all our other organs, has been shaped by natural selection. Brain tissue is metabolically expensive both to grow and to run, and it strains credulity to think that evolution would have permitted squandering of resources on a scale necessary to build and maintain such a massively underutilized organ.

Moreover, doubts are fueled by ample evidence from clinical neurology. Losing far less than 90 percent of the brain to accident or disease has catastrophic consequences. There does not seem to be any area of the brain that can be destroyed by strokes or other trauma without leaving the patient with some kind of functional deficit. Likewise, electrical stimulation of points in the brain during neurosurgery has so far failed to uncover any dormant areas where no perception, emotion or movement can be elicited by applying these tiny currents. (This can be done with conscious patients under local anesthetic because the brain itself has no pain receptors.)

With the aid of instruments such as EEGs, magnetoencephalographs, PET

scanners and functional MRI machines, researchers have succeeded in localizing a vast number of psychological functions to specific centers and systems in the brain. With animals, and occasionally with human patients undergoing neurological treatment, recording probes can even be inserted into the brain itself. Despite this detailed reconnaissance, no quiet areas awaiting new assignments have emerged.

The 10 percent myth has undoubtedly motivated many people to strive for greater creativity and productivity in their lives—hardly a bad thing. The comfort, encouragement and hope that it has engendered helps to explain its longevity. But, like so many uplifting myths, the truth of the matter seems to be its least important aspect.

What causes headaches?

—Mike A., Wilmington, Del.



Dawn A. Marcus, an associate professor in the departments of anesthesiology and neurology at the University of Pittsburgh School of Medicine, explains:

ALTHOUGH THEY MAY FEEL as if they are located in the brain, headaches actually arise because of irritation of nearby structures: skin, joints, muscles, nerves or blood vessels. Brain tissue, encased in the protective coating of the skull, has not evolved the ability to respond to pressure sensations.

Clinicians classify all headaches as either secondary or primary. Secondary headaches, which appear as symptoms of an underlying disorder, have no uniform cause. Anything from a pinched nerve to a sinus infection can lead to secondary head pain.

Most headaches, however, are primary, meaning that what is wrong is

“The 10 percent myth has undoubtedly motivated many people to strive for greater creativity and productivity in their lives—hardly a bad thing.”

not a condition preceding the headache but the headache itself. Research suggests that this type—which includes tension headaches and migraines—may derive from a single, identifiable pathway.

The chain begins when pain centers in the brain are activated, at which point they produce neurotransmitters such as serotonin and norepinephrine. These chemicals call for expansion of meningeal blood vessels enveloping the brain, which results in increased blood flow. As the vessels swell, they stretch the nerves that surround them. These nerves, in turn, convey signals to the trigeminal system, an area of the brain that relays pain messages for the head and face, and we perceive pain.

Why the pathway is initiated at all is still an open question, although some circumstances seem to make headache onset more likely. These triggers may be internal (for example, hormonal changes during menstruation) or environmental (such as stress or sleep deprivation). So far most evidence for what factors are directly responsible is anecdotal, and the mechanism by which triggers are converted to chemical signals is little understood. **M**

Have a question? Send it to editors@sciammind.com

Head Games

Match wits with the Mensa puzzler

BY ABBIE F. SALNY

1 A toy store owner prices merchandise according to her own system. A drum costs \$7; a hoop costs \$6; a video game costs \$13. Using the same logic as the owner, determine how much a basketball will cost.

2 Fill in the missing letter.

C	A	U	S	E	T
O		V			
Y	N	L	O	I	H

3 The same six letters, rearranged, can be used to fill in the blanks in the sentence below.

The designer made a beautiful collection in _____ colors, with _____ in the skirts and the _____ possible shades.

4 What three-letter word may be placed in front of each of the four words below to make four new words?

___ NOT ___ NON ___ DID ___ CELLED

5 The following 24 letters can be rearranged into a five-word phrase describing a savory menu item.

B C D E E E E F I I M N N O O O P P R R R T T

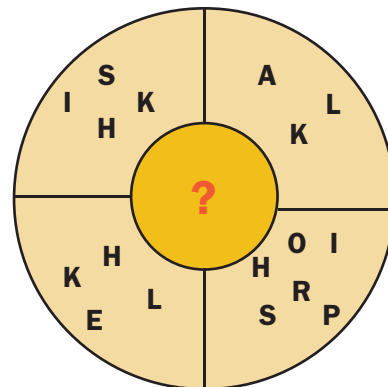
6 Which of the following words is the "odd man out"?

ITALY
DOCILE
CANED
WORKED

7 Fill in the missing letters to find the "impassable" word.

I _ _ E N _ T _ A _ _ L _ T _

8 Unscramble the letters in each of the "pie" segments. Then find the missing letter in common that makes each of the four segments a good English word.



9 Jim is now twice as old as Jane was two years ago. In two years, Jane will be four fifths of Jim's age. How old are they now?

10 If six teenagers can gobble up 18 pizzas in one hour, how many teenagers will it take to eat nine pizzas in an hour?

Abbie F. Salny, Ed.D., was the supervisory psychologist for American Mensa (www.us.mensa.org/sciamm) and Mensa International (www.mensa.org) for more than 25 years. She is the author and co-author of many challenging puzzle books, including the Mensa Think-Smart Book and the Mensa 365 Brain Puzzlers Page-A-Day Calendar (Workman Publishing).

Answers

1. \$17. (\$2 per consonant and \$1 per vowel.)
2. S. (Start at the upper left to spell out "Can you solve this?")
3. Paste!, please, palest.
4. Can (cannot, cannon, candid, cancelled).
5. Prime rib done to perfection.
6. Worked. The other three words are anagrams for another word.
7. Impenetrability.
8. W. (worsnip, walk, whisk, wheel).
9. Jim is 8, and Jane is 6.
10. Three. Each teenager eats a pizza every 20 minutes.

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Soldiers fight in particularly stressful conditions in Iraq. Friend and foe are difficult to discern, and “success” is far from clear. Psychologists in Iraq are helping soldiers combat their emotional and mental scarring.

The Halle Berry Brain Cell

Networks of neurons were once thought necessary for storing and retrieving memories. Now studies find that one cell can respond to the image or name of an individual, such as Halle Berry or Bill Clinton. Neurons may specialize to a degree previously unknown.

A Look Inside ►

When two people imagine the same thing, does it actually “look” the same at all? And how do our brains create mental pictures that we see with the mind’s eye?

Do Gays Have a Choice?

Sexual orientation was once thought to be a psychological aberration. Then research raised the issue of genetic predetermination. Which is it? The answer is not so simple.

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ARKO DATTA Reuters/Corbis (top); IMAGES.COM/CORBIS (bottom)